# PUBLIC WORKS

*Devoted to the interests of the engineers and technical officials of the cities, counties and states*

FEBRUARY, 1940

A. PRESCOTT FOLWELL, Editor — VOL. 71. NO. 2 — W. A. HARDENBERGH, Asso. Editor

## Contents



## TIMEWASTERS

This month, for various reasons, but principally because we have a head cold that makes even timewaster mathematics a burden, we give you one little problem—but what a one!

### The Bandit's Children

A bandit returns to his motherless and moneyless children with a wallet full of $2.00 bills and seven mules carrying bars of gold and silver bullion. Each mule carries seven bars and is loaded to its full capacity but no two mules carry equal total weights. The bullion is deposited in a cellar where there is a pair of scales, but the only weights present all weigh 75 lbs. each.

During the night the bandit dies and next morning his two sons agree to share the mules in such a way that the total carrying capacity of each brother's mules will be equal, any mules left over being given to the third child, a sister. Each child is then to take the bullion, without breaking any bars, which his or her mules will carry. They discover that all the gold bars are equal in weight and all the silver bars are equal in weight, that 8 gold bars weigh as much as 13 silver bars, that 7 silver bars weigh more than two 75 lb. weights, but 7 gold bars weigh less than four 75 lb. weights.

There is an even number of $2.00 bills so the brothers divide them and then the older brother gives the younger one a $2.00 bill to purchase his half of the wallet.

You are told that after this transaction the product in dollars of their respective amounts of money is equal to the total weight in pounds of all the bullion plus one 75 lb. weight. What will the mules carry and how were they divided?

Thanks to John A. Bevan.—W.A.H.

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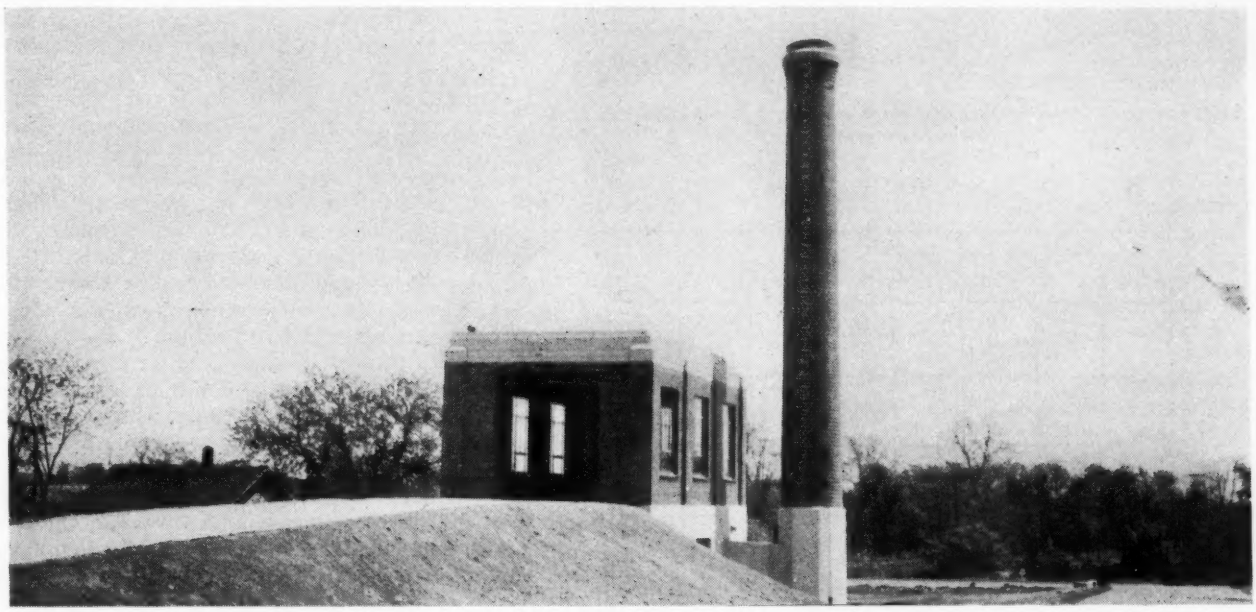


This Nichols incinerator at Oxford, O., has a capacity of 20 tons in 24 hours.

# Garbage and Refuse Collection and Disposal Practices in Small Communities

### A survey by the Editors of Public Works Magazine

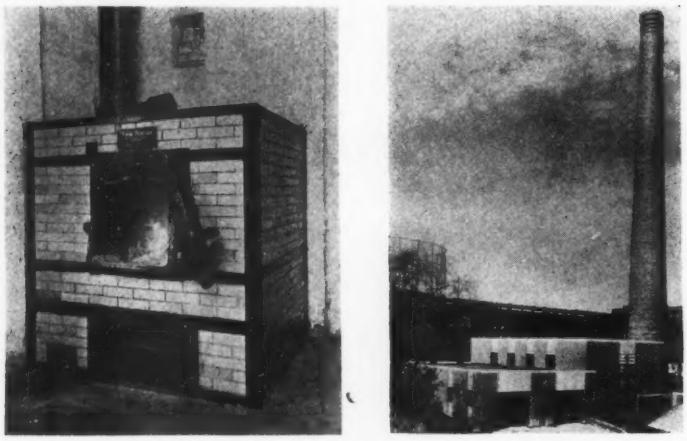
GARBAGE and refuse disposal data have been collected by PUBLIC WORKS from approximately one thousand communities of less than 4,000 population through the cooperation of mayors and village clerks of these communities. It was realized that many of these smaller communities would not be able to answer all of the questions asked; however, the information obtained is exceedingly valuable and represents, we believe, the first complete data on practices in communities of relatively small size. Because of the large number of communities replying, it is not possible to list the names of all. PUBLIC WORKS take this occasion to thank those who returned the filled-in questionnaire.

Replies show that approximately 70% of the communities have an organized system of collecting refuse. Of those having organized and regular collection systems, 42.2% collect with municipal forces; in 31.3% collection is by private collectors; and in 26.5%, collection is by contractors, the contract usually being made between the collector and the municipality, though in some cases the collector is merely licensed. In some cases several licenses are granted and each collector deals directly with the individuals whom he serves.

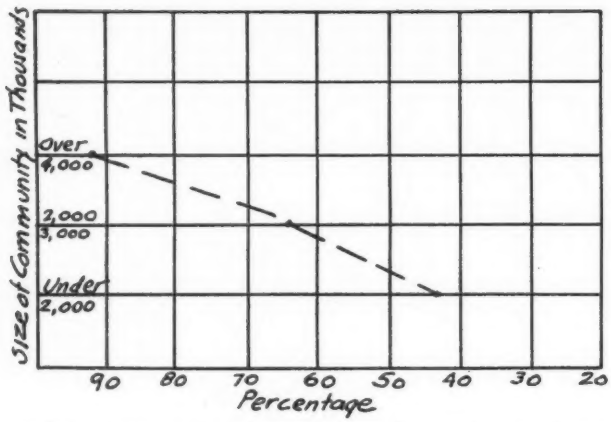
A tabulation was made showing the relation of population to organized collection. This tabulation shows that in the case of communities of less than 2,000 population, only 42.4% have organized collection service; in places in the 2,000-3,000 range, 63.4% have organized collection; in the group of communities with more than 3,000 population, 91.7% have organized and supervised collection service.

#### Frequency of Collection

Garbage collection service is provided (in those communities having organized service) with frequencies varying from one a week to every day. The same is true of refuse collection service, though in most cases refuse (inorganic materials) is collected



Left, very small Morse-Boulger destructor unit; right, a municipal garbage incineration plant.




Relation between size of community and collection of refuse.

somewhat less frequently. In regard to garbage, 26.5% of the communities provide one collection a week; 40.0% provide two collections a week; 17.0% provide three collections a week; 2.4% provide four collections a week; and 14.1% have daily collections. The number of communities reporting daily collections is surprisingly large and may be due to misunderstanding on the part of reporters; possibly many of them have daily collections from restaurants and similar places, but less frequent collections from residential areas.

Collections of inorganic materials were reported as being made once a week in 40.8% of the communities; twice a week in 37.2%; three times a week in 9.2%; four times a week in 1.3%; and daily in 11.5%. Here again the proportion of every day collections appears unduly high.

The information supplied in regard to the point of collection is interesting and appears to bear out the belief that a growing number of communities do not wish to see garbage and rubbish containers standing along the streets waiting for the collector to appear. While 3.3% state that they collect from either curb, alley or back door, only 23.1% make their collections from the curb only. On the other hand, 42.8% report collections from the alley and 30.8% from the back door. In northern states, where snow makes winter collection more difficult, procedure is sometimes changed; alley or back door collection is the practice in the summer, and curb collection in the winter.

Frequency of collection in winter and in summer varies somewhat; but of the communities which reported collections as frequently as once a week, the number of collections is the same winter and summer in 77% of them, while in the remaining 23% more frequent collection service is provided in summer.

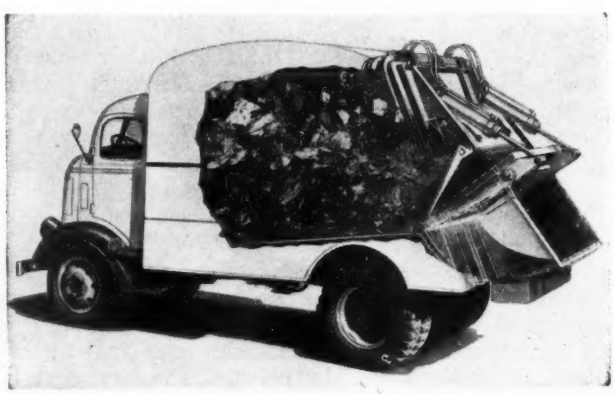
Charges assessed for collecting garbage and other waste materials vary from 20 cents a month to more than a dollar. An interesting fact is that the great proportion of communities have realized the soundness of making the charge for waste collection the responsibility of the entire community. Slightly more than 78% of the communities reporting state "no charge is made," "paid out of taxes" or "charge collected with taxes." One community reports that the charge is added to the water bills.

In 34.7% of the communities reporting, the charge is $1 per month, which ordinarily cares for all collection service; in 9.9% the charge is 75 cents a month; in 32.0%, the charge is 50 cents a month; in 9.9%, it is 35 to 40 cents a month (in a few cases $2.50 for 6 months); in 13.5%, the charge is less, varying from 20 to 30 cents per month. In some cases it was not clear whether this charge was for garbage alone or both garbage and other refuse.

Practically none of these smaller communities keep any reliable records of the amount of garbage collected per person, its moisture content, its weight per cubic yard, or the total amount of wastes of all kinds collected. Fairburn, Ga., reports that the weight per cubic yard there varies from 300 to 500 pounds and that the total collected per person per yard is about 300 pounds. Leetsdale, Pa., reports 175 pounds of garbage per year per person. Evansville, Wis., reports "about 900 pounds per family per year." Several communities close to 2,500 population report "one truck load per day." (Such trucks are usually 1½ or 2 tons capacity.) No other communities have data of value on this. Several reports from larger communities were received (apparently questionnaires were sent out to these in error) and data from them will be included in a later article covering the same general information for larger cities.

### Disposal of Refuse

In methods of disposal, open dumps led with 50.2% of all methods reported; feeding to hogs was second with 31.6%; covered dumps were reported by 6.6%; burial by 6.2%; incineration by 4.8%; and sanitary fill by 0.6%. None reported disposal by grinding. These replies indicate that realization of the value of proper disposal of refuse and garbage is lacking in many areas.



The Gar Wood Load-Packer body

**Closed and low-loading body of Municipal Sanitation Corp.**

As a matter of interest and to give information on the effect of geographic location on methods of disposal, a tabulation was made of the first 500 reports received stating the method of disposal. (Subsequent studies showed that results were not altered appreciably by additional reports.)

### Methods of Disposal for 500 Small Communities

| *Section of U. S.* | *Incineration* | *Open Dump* | *Cov. Dump* | *Burial* | *San. Fill* | *Hog Feed* | *Total Reporting* |
|---|---|---|---|---|---|---|---|
| New England .... | — | 7 | 1 | 2 | — | 12 | 22 |
| North Atlantic ... | 9 | 40 | 15 | 8 | 1 | 30 | 103 |
| South Atlantic .... | 6 | 31 | 4 | 2 | — | 6 | 49 |
| East North Central | 3 | 44 | 7 | 7 | — | 59 | 120 |
| East South Central | 1 | 28 | — | — | — | — | 29 |
| West North Central | 1 | 49 | 5 | 5 | — | 24 | 84 |
| West South Central | 4 | 25 | 1 | 3 | 2 | 7 | 42 |
| Mountain ..... | — | 11 | — | 2 | — | 5 | 18 |
| Pacific ..... | — | 16 | — | 2 | — | 15 | 33 |
| Total ..... | 24 | 251 | 33 | 31 | 3 | 158 | 500 |

It is of considerable interest to note that, whereas these smaller communities plan to build something like 36 sewage treatment plants in the near future, only seven of them have the construction of an incinerator in mind. The necessity or desirability of proper disposal of wastes—and also the collection and handling in proper vehicles—has not been sold as effectively as has sewage treatment.

### Collection Vehicles and Hauling

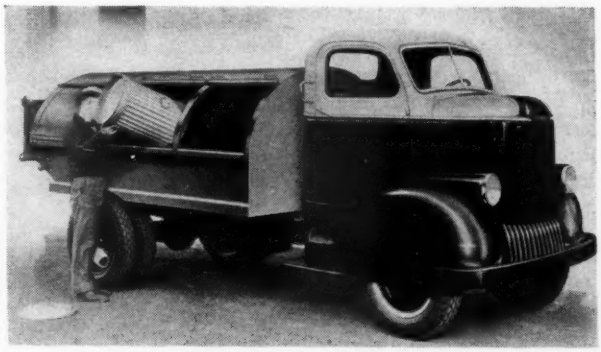
While about 5% of the communities reporting use horse-drawn vehicles still, the remaining 95% use an average of 1.6 motor vehicles each. These are principally in the 1 to 1½-ton group, though smaller and larger trucks are used—2-ton and 3-ton vehicles are quite popular. Slightly over 50% of all trucks for which size was given were in the 1-1½-ton group, and another 20% in the 2-ton group; ½-ton and 3-ton between them had another 25%, just about equally divided.

Body sizes reported ranged all the way up to 10 cubic yards, but by far the most of them were 3-yard and 4-yard. Modern covered metal bodies were reported as being used by 14.7% of the communities. If these are of the types shown elsewhere in this article, the showing is a remarkably good one, but it is probable that a number of them listed in this category had the sliding metal cover. While these are a great improvement over the uncovered bodies or over those covered with a canvas sheet, there is still room for improvement in this respect.

Hauling distances reported ranged from half a mile to 45 miles, but the great bulk of hauling varied between 2 and 5 miles, this group representing about 70% of the reports.

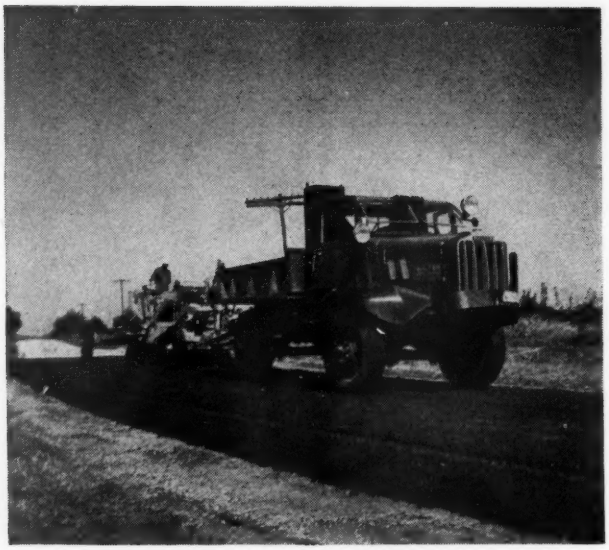
Many interesting comments were received, ranging from the statement that "these are the darndest questions ever sent to a small town like ours" to concise summaries of conditions, such as the following:

"Refuse and garbage disposal, in the City of Port Townsend, Washington, is by concession. Bids are tendered the city upon call. Contractors are customarily asked to bid upon basis of one, two, or three year contract each. Present contract is for period of three years, expiring Feb. 1, 1942. Collection is made weekly in the residence district, and thrice-weekly in the business district, by motor truck with box body and adjustable canvas cover to prevent scattering. Charges are 75c per month for residences and $2.00 per month for business houses having thrice-weekly service. Disposal is at city-owned dump, outside city, and reasonably removed from all habitation. Citizens have privilege of removing their own refuse, privately, but for-hire removal can be by contractor only. *C. F. Christian.*



**Low loading features this Anthony body**

A completed Road Surface in Kane County



Laying Tar-bound mix in Kane County

# How Two Midwest Counties Use Tar for

**Procedure in building tar-bound gravel mixes are described by C. L. Hanson, County Highway Superintendent, Kane Co., Ill., beginning on this page**

A SURVEY of the Kane County, Illinois, road system made a few years ago showed a considerable mileage of traffic-bound gravel roads of an average thickness of six inches. The county board wished to improve these with a smooth, dustless riding surface at the lowest possible annual cost. It was clear that we could not afford to rip up these gravel roads. Therefore, we needed to discover what types of wearing surface could be constructed sufficiently thick to meet all our requirements as to traffic and sufficiently inexpensive to permit an appreciable mileage each year. After investigation of gravel bituminous work in other states, it was decided to attempt a mix using tars for binder and the local gravel as it came from the pit after crushing the larger sizes. To test this out, two projects were built in 1936, and increasing amounts each year since then.

The gravel obtained from the local pits is crushed and screened with a portable plant to meet the specifications under which our roads are constructed, which are as follows:

| | |
|---|---|
| Passing 1" sieve | 95% to 100% |
| Passing ½" sieve | 65% to 85% |
| Passing ¼" sieve | 45% to 60% |

The year prior to the construction of the bituminous surface, the existing gravel roads are inspected for thickness and additional gravel added where necessary to correct any deficiencies. The gravel base, thus reconditioned, is subjected to traffic through the winter and spring months.

Prior to priming the road, and when the base has dried sufficiently, the gravel loosened by traffic is bladed uniformly over the surface and rolled with a ten-ton roller to smooth and compact the surface. Tar prime, RT-2, is then applied at the rate of 5/10 of a gallon per square yard. By this method all of the base material is utilized and the intended thickness of the base is maintained.

When the primed surface is opened to traffic, the cover coat mixture is prepared by either a travel plant or a central plant. Using the travel plant method, the cover coat aggregate is hauled and spread on the primed surface for sun and wind drying, care being taken in spreading the gravel for drying so as not to spread wider than the primed surface, thus permitting foreign material to become mixed with the clean gravel. After drying, the gravel is bladed into a windrow along the center of the road. The amount of gravel hauled is of sufficient quantity to produce a finished surface twenty feet wide and 2½ inches thick, the compacted thickness, after rolling, being nearly two inches. The total aggregate required per mile is approximately 860 cubic yards.

Using a travel plant, consisting of a loader and a mixer, the dried aggregate is elevated into a hopper and measured through a gate opening before entering the pugmill mixer. As the gravel enters the pugmill, a metered amount of tar enters with it. When the mixture leaves the pugmill and is deposited in a windrow, it is correctly proportioned and of such an amount to produce the desired thickness of surface.

When a central plant method is used, the same travel plant can be located in the local gravel pit from which the aggregate was hauled in the above method of construction. Using this method, the aggregate is put through a drier before mixing. The mixed material is trucked to the section and deposited in a finishing machine which spreads and partially compacts a surface one-half the width of the finished surface at a time.

The mix is so set that a square yard of the finished

Huber Roller on St. Joseph County Roads

One of St. Joseph County's Surfaces

# Gravel Surfacing and Soil Stabilization

**Starting on page 14, Ralph Witt, County Highway Supervisor, St. Joseph Co., Ind., describes Indiana methods of Soil Stabilization with tar**

surface contains 1.1 gallon of tar or approximately 13,000 gallons per mile. The tar used meets the Illinois specifications for RT-7 and RT-8, the former being used early in the season during cooler weather, and heated to a temperature of approximately 175 degrees F., in the tank car by a 10 H.P. portable boiler. The heated tar is then transported to the plant in a distributor. When the travel plant is used, it is in continuous operation, the transfer of tar being made while the plant continues in motion.

Spreading material in Kane County

The spreading and rolling of the mixed windrow follows the mixing operation in such a way that the length of windrow mixed one day is usually spread and rolled the following day. In this manner, traffic is able to make full use of the entire completed surface to a point approximately one-half mile back of the travel plant. Before the windrow is spread with a blade grader, the primed surface is thoroughly swept by manipulating the windrow first to one side of the road and then the other. The first spreading is done to equalize the material in approximately an eighteen foot width. Then the top half layer is bladed into a small windrow at the center of the road and the bottom layer of the mixed aggregate is rolled several times with a rubber tired roller to thoroughly knead and compact that part of the mat. The spreading of the small windrow to the full twenty foot width then completes this operation, which is immediately followed by a combined rolling of the top surface with the rubber tired roller and a ten-ton three-wheeled steel roller. The finishing touch is given to the appearance of the mat by rolling each edge to a uniform line, the rolling being done on a 45° slope accomplishing this by means of a small roller attached to the mouldboard of a blade grader. During the various spreading operations, the mixed material is so aerated that the preliminary setting of the material is hastened sufficiently to allow traffic to use the surface after the first rolling. Rolling is then continued for two days and traffic completes the rest of the ironing and smoothing process.

A fog coat of the same grade of tar as used in the mixing operation is applied after the final rolling to seal the surface which has dried somewhat in the spreading and rolling operations. This application is at the rate of from 1/10 to 15/100 of a gallon per sq. yd.

**Mixing with diesel grader, St. Joseph County**

The existing shoulders are raised to meet the grade of the completed bituminous surface, and to protect the edges of the mat, by the addition of gravel tapering off at a point about 2′ 6″ from the edge of the mat.

The complete operation, from adding gravel to strengthen base to the finished treated surface, including added gravel to protect edges, costs between $4,000 and $5,000 per mile. Varying length of haul for both aggregate and bitumen cause the wide variation in cost per mile.

It has been found that surface treatments are generally unnecessary the same year as construction. Instead, a light fog coat of from 1/10 to 15/100 gallon per square yard, without cover, is applied to the surface within a month after completion of the wearing course, and traffic permitted to use it as soon as sufficiently dry to prevent picking up. Some of the 1937 construction was handled in this manner and left untreated until 1939 with no apparent ill effect. It is possible that, with a light fog coat every two years, surface treatments may be delayed at least five or more years after construction.

So pleased were the county supervisors and the public in general with the results obtained, that the program progressed with great rapidity in 1938 and 1939. At the close of the 1939 season a total of 85 miles had been constructed, all of which is in excellent condition, requiring little or no maintenance.

## Soil Stabilization With Tar

**By RALPH WITT**
**County Highway Supervisor, St. Joseph County, Indiana**

INDIANA has become interested in the problem of water-proofing old traffic-bound foundations with an admixture of tar. It is the purpose of this process to prevent the fines (clay, silt, or loamy material passing 200 mesh sieve) from becoming detrimentally wet without disturbing their binding qualities.

This discussion is based on experience and observation of work of this type in Indiana during 1938 and 1939, and covers thirty projects for a total of eighty-seven miles. This mileage includes state and county highway projects, city streets and alleys, airport runways, parking lots and play grounds. The depth of foundation has varied from 4 to 11 inches, but the trend seems to be to standardize on a compacted depth of approximately 6 inches. In highways additional thickness is used at the edge for greater stability.

Standard methods of scarifying and loosening the material are followed and continued until the fine material is reduced to lumps no larger than ½ inch.

Where the untreated material shows a marked deficiency of moisture, water is applied. The tar is added in two or more applications. Each application is incorporated with a portion of the loose material. Mixing is accomplished by repeated windrowing with single-blade graders. This operation is continued until the mixture has been completed and excess moisture dissipated.

The processed base is then laid out and compacted. A tack coat with a small amount of free cover is applied immediately. This is now a complete processed *base,* but not a finished job until some type of wearing surface has been applied.

It is recognized that there exists an ideal moisture content, which permits the mixing to be done much more rapidly—probably the mass need be turned only one-half as many times. Too much moisture as well as too little moisture, requires more mixing. Tolerance in moisture content of 2%, as given in laboratory findings, is difficult to meet in practical application, and Indiana does not attempt to arrive at this ideal moisture content; in fact, only where there is practically no moisture present is water added. Observation and experience are the guiding factors.

The spectacle of a highway engineer praying for rain on a bituminous job is refreshingly novel.

It must be realized that this process, which is designed to exclude water, is equally effective in confining any excess moisture within its mass. Hence, it is necessary to make certain that the structure is not sealed by rolling until it has been determined that there are no areas containing excess moisture. It is not uncommon to find, after rolling, local areas where excess moisture has been sealed in. Any such areas must be opened to the air and allowed to dry out before surfacing. In one instance, a road containing excess moisture was rolled and sealed, and after two years it was necessary to open this road and allow the moisture to escape.

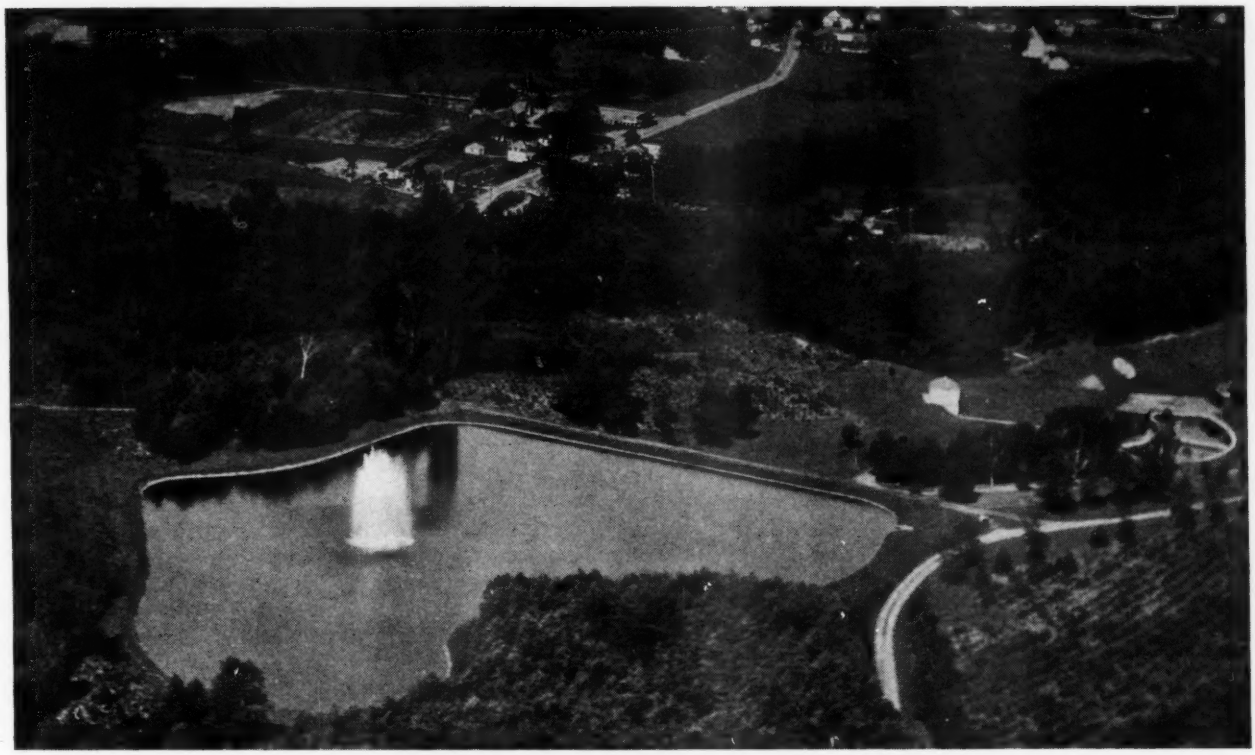
It is a definite jolt to an engineer who has spent years fighting to get clean aggregate for bituminous work to find himself mixing tar and mud. However, he may ease his conscience with the following quotation: (Soil Stabilization, Hogentogler) "Bituminous material coats the soil more readily after the air films have been removed. Wetting or moistening of the soil before application prepares the soil particles for the bitumen."

### Mixing

The mixing process is carried on by established roadmix methods, except that we are working to a greater than ordinary depth. Due to the greater depth and the larger sized aggregates encountered, the use of spring-tooth and disc harrows is to be abandoned. Heavy single-blade graders have the following advantages: (1) They give a complete turnover of the entire mass in one operation. For this reason, any possibility of segregation is eliminated. (2) They impart a rotary grinding action which seems to be selective to the extent that the fines are thoroughly coated, leaving the larger aggregate substantially uncoated.

It is particularly interesting to note that only part of the total mass is actually coated with tar. Practically

*(Continued on page 44)*

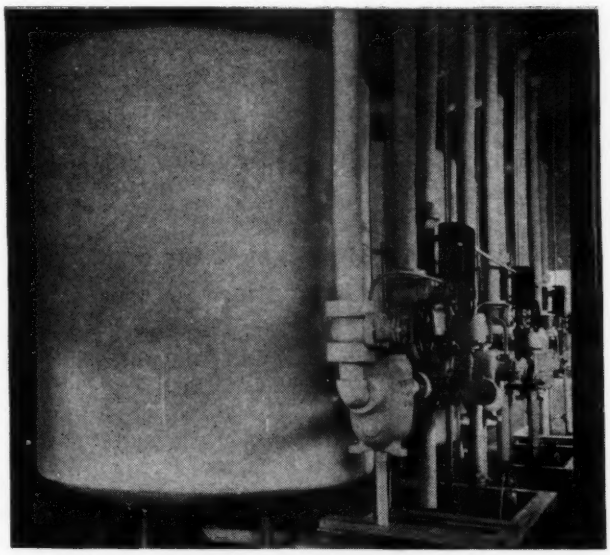


View of Reservoir and Aerator. Softening building in right background

# Water Improvements at Ilion Include Softening

By EARLE J. TRIMBLE

Supervising Engineer, Board of Water Commissioners
Ilion, N. Y.



Permutit Zeolite Softeners

ILION'S water purification system is of historical interest as its filtration plant was the third slow sand filter to be constructed in the United States. The date of installation was 1892, and these filters, after 47 years, are still in daily use.

The original plant consisted of a 15,000,000-gallon reservoir and two slow sand filters with a total capacity of 1,000,000 gallons per day. In 1902, two more filters were added and reservoir No. 2, with a capacity of 65,000,000 gallons, was constructed.

In 1917 two more filters were added, and in 1922 work on No. 3 reservoir with a capacity of 160,000,000 gallons was started. The total capacity of these three reservoirs is 240,000,000 gallons. In addition, there is a clear well with a capacity of 1,000,000 gallons.

The flow is entirely by gravity, so no pumping equipment is required. The direction of flow is from No. 3 and No. 2 reservoir to No. 1 reservoir, thence through the filters to the clear well and from there, also by gravity, to service. The elevations are sufficient to afford a pressure of about 95 to 100 lbs. per square inch in the center of the city.

Prechlorination with chlorine and ammonia and post-chlorination are both practiced. Prechlorination is applied in Reservoir No. 1 and has served to keep down algae growths and to increase the period between filter washings. In fact, it has been possible to maintain a sufficient residual chlorine content with prechlorination alone so that post-chlorination is simply an additional safeguard.

Ilion, therefore, for some 47 years has been getting a clear, filtered water supply, which has been satisfactory in every respect except for hardness. This hardness content varies in the different reservoirs and is also subject to seasonal variations. Roughly, the hardness in No. 3 reservoir varies from 7 to 10 grains per gallon; in No. 2 reservoir from 12 to 25 grains per gallon; and in No. 1 reservoir it averages usually around 13 to 14 grains per gallon.

It is generally recognized that a municipal water

**Built by W.P.A. to house the softening equipment**

supply, in order to be satisfactory for general purposes, should not have a hardness of more than some 5 or 6 grains per gallon; therefore, Ilion's water supply, while satisfactory in other respects, had a hardness which varied from 1½ to about 5 times as hard as it should be.

Numerous complaints had been received on this score, so last year the city decided to soften the entire supply to approximately 5 grains per gallon. After making a thorough study of the various methods of water softening, it was decided that an automatically operated zeolite water softening plant was best suited to the city's needs.

It was also decided that the location of this plant should be below No. 1 reservoir, as this permitted a gravity flow throughout, and made available the use of the 1,000,000-gallon clear well as a storage basin for the softened water. A building for housing the softening equipment was required, and it was decided to erect one of sufficient size to allow space for additional softening equipment to take care of future needs. This building was made by W.P.A. labor from stone quarried at Fox's Falls, on property owned by the Water Commission. It is a handsome, substantial building, measuring 50 feet by 40 feet.

The water softening equipment, supplied by the Permutit Company, consists of three fully automatic zeolite water softeners, each unit being 96″ in diameter by 9′ high. This plant has a capacity for softening 1,750,000 gallons per day of 13-grain water to 5 grains. Room has been left for installation of a fourth water softening unit, whenever that may become necessary.

The salt-handling equipment consists of an 80-ton capacity concrete wet salt storage basin, with an auxiliary 48″ diameter brine measuring tank. The wet salt storage basin is on the hillside, above the softener building, and the brine flows by gravity to the auxiliary brine measuring tank, which is situated in the softener building.

All piping in the building, as well as the softener units themselves, are covered with insulating material. This prevents sweating and keeps the equipment and building dry. For protection of the distribution system, an alkali-silicate feed, of the pressure solution type, is provided.

The softening plant was put in operation June 3rd, 1939. Its performance has been very satisfactory and the citizens are very enthusiastic about the softened water and take a great pride in their new plant.

## Solving the Frozen Riser Problem in Elevated Tanks

Riser pipes of elevated steel tanks often freeze in the winter and may cripple the water department. This is especially true in tanks having small diameter risers. Large risers generally do not freeze solid. Wall, S. D., had this experience in the winter of 1936-37. The riser froze up and put the water works out of business for quite a period of time. New pipe was required and the incident cost the city a considerable amount. Last winter, however, the city put an additional pipe around the riser so that there was about 18 inches of air space between the two pipes. The outer pipe was home-made and did not have to be expensive pipe because it carried no pressure. At the bottom of the riser a small concrete vault or pit was constructed having an opening in the top into the air space around the riser. A small distillate burning stove was installed in the pit with a draft line running out into the air. The pipe around the riser acts as a large stack and heat from the stove keeps the space around the riser warm. Only a very small fire in the stove is needed and the stove need not be run except in freezing weather. Some trouble was encountered at first in that the stove kept going out but this was soon remedied by extending the small pipe which serves as a draft line.—*The South Dakota Clarifier.*

## Electrical Thawing of Water Pipe

The season is again approaching when water works superintendents will have added to their duties the thawing of services and mains. During the first few issues of PUBLIC WORKS this year we published suggestions from several superintendents relative to electric thawing. Among these was Louis M. Weld, president and manager of water works at Meyersdale, Pa. Too late to be of timely interest last spring, we received some additional details from Mr. Weld, which we give below.

In thawing services, he makes connection to the service line in the house by means of a clamp. Connection in the street is made at the curb stop by means of a copper rod that has, on the lower end, a strong spring clamp that can be forced down on the tee handle of the curb stop. Their services are all copper, and they use a 4-0 cable, which offers less resistance than the copper service.

A portable transformer is used, stepping 110 or 220 volt current down to 10 or 20 volt secondary current, delivering 1000 or 500 amperes, respectively.

This is sufficient to thaw 8″ cast iron pipe. No lead joints have even been damaged with this; but they have been damaged by arc welding machines and no one is allowed to use such machines on cast iron mains in Meyersdale.

## Maximum and Minimum Rates of Water Consumption

In Milwaukee, Wis., during the year 1939 the average daily consumption was 91,643,835 gal., equivalent to 129.25 gal. per capita per day. The highest consumption for any one day was 147,690,000, on August 1. The maximum hourly consumption was at the rate of 219,000,000 gpd., between 6:30 and 7 p. m. July 13, reaching 271,400,000 between 6:30 and 6:45. The lowest rate for any one day was 61,590,000 gal. on December 3. The all-time maximum 24-hour consumption occurred on July 13, 1936, when it was 160,604,000.

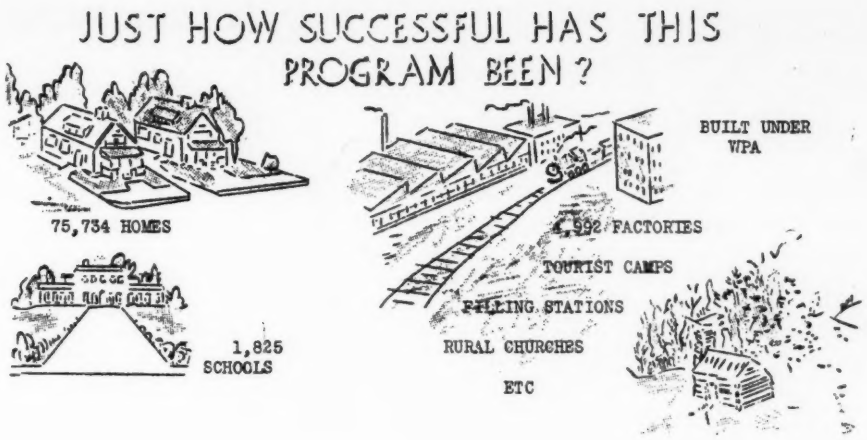
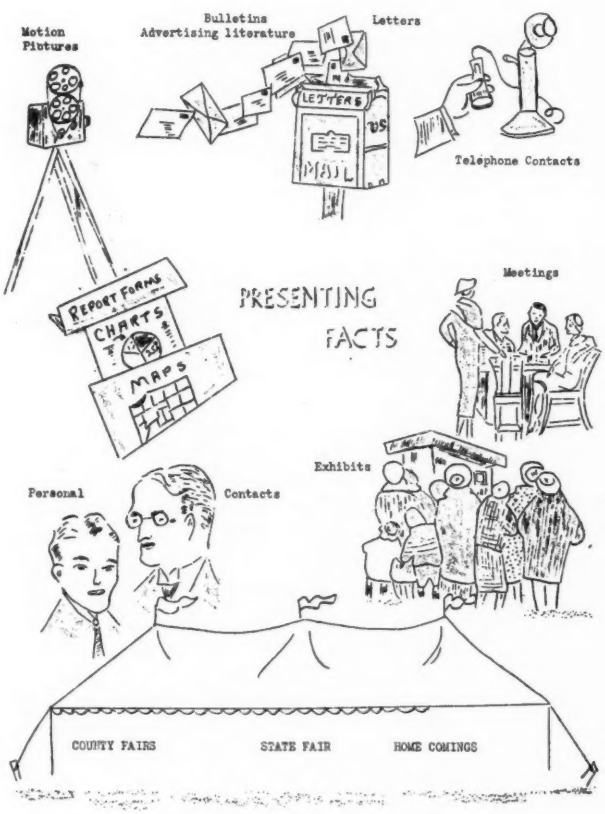



Illustration from "Facts" on Community Sanitation

# "Facts" Regarding Community Sanitation

INAUGURATED a few years ago, the Community Sanitation Program has been carried on in a number of states cooperatively with the Federal Government. This program consists of a state-wide educational and construction program to safeguard public health by eliminating unsanitary conditions on either public or private property, thereby reducing or preventing filth-borne diseases.

Through D. John Turpin, supervisor of a part of the program in Indiana, we have a report on the accomplishments to date in that state, as well as a view of the sound educational program that has formed a portion of the campaign. This report is presented in a mimeographed booklet "Facts."




Methods of education used

The educational program is aimed to teach the public the ways by which filth-borne disease are transmitted. Two motion picture outfits and various films have been available. One district supervisor devotes his entire time to educational work. During the 12 months following July 1, 1938, 290 meetings were conducted, with a total of 100,042 persons attending. Exhibits were displayed intensively at group meetings, county fairs, homecomings and state fairs. A total of 35,000 pieces of advertising material and mimeographed articles dealing with sanitation and related health matters were distributed, in addition to 15,200 calendars. Approximately 5,000 inches of newspaper publicity was obtained. Some 12,600 monthly bulletins were also mailed out.

A series of six cartoons and short articles dealing with community sanitation was prepared and supplied to local newspapers. A preliminary letter was sent describing these; the letter was followed with a personal call by one of the district supervisors. A portion of the program called for visits to town, village and city officials to emphasize the need for enforcement of existing ordinances or the adoption of adequate ordinances where none existed.

The general program of education followed the "most common routes for the transmission of" the filth-borne diseases—water, milk, food, flies and personal contact. A simple program of educational material was prepared for each of these phases of the work.

The need for such a health project was shown by figures indicating that of the 3,262,000 people in the state, according to the 1930 census, 1,862,000 did not have access to a public sewer. The fact that 1,612,000 do not have access to a public water supply indicates that the simplest method of waste disposal is needed in a great many cases.

To June 30, 1939, sanitary facilities had been provided for 75,734 homes, 1,825 schools and 4,992 factories, tourist camps, filling stations, rural churches, etc. In addition to this total of 82,551, 25,228 additional

facilities were installed in the earlier stages of the campaign.

The total cost of construction on the 107,779 structures completed was $6,050,527.59, of which $1,945,180.83 was contributed by the people benefited. An average of 1100 men, all from the relief rolls, have been employed for an approximate total of 7.4 million hours.

While it is obvious that, under the conditions existing in Indiana, the simplest type of sanitary facility—the pit type of toilet—was necessary in most cases, the advantages of sewer systems and of septic tanks were constantly emphasized, as being far superior where conditions were such as to permit their construction.

Regarding septic tanks, "Facts" says: "The most satisfactory and convenient method of disposal of sanitary wastes from isolated residences equipped with running water is through a septic tank followed by a subsurface filter system. This system is capable of removing the objectionable constituents of sewage sufficiently for the prevention of insanitary or nuisance conditions below the point of discharge. By making use of a septic tank, treatment of the sewage is accomplished by the settling out of the solid material which is acted upon by bacteria and converted into a stable, non-odorous form. Bacterial action also takes place in the filter bed. . . . The septic tank should be located at least 50 feet, and preferably 100 feet, from a well supplying drinking water."

Regarding municipal or community sewerage systems, "Facts" says: "When the economics will permit, a municipal sewer system and sewage treatment works should be utilized. The sewer system is the collecting system for the liquid wastes of the community, such as from kitchens, bath tubs, toilets and various industrial plants. The objects of sewage treatment are threefold," these being to stabilize organic matter, destroy or remove harmful bacteria and protect health.

Fortunately there have been included records on typhoid fever deaths, which indicate a steady reduction in the occurrence of this disease. Whereas in 1910, the typhoid death rate was 34.6, it had declined to 8.0 in 1925, to 3.7 in 1929 and to 2.9 in 1933, when the community sanitation program began. In 1936, it was 1.8, in 1937 it was 1.1 and in 1938—the last year for which full records are available—it was 0.9. Infant mortality also was reduced—from 36.3 in 1910, to 19.0 in 1930, to 8.7 in 1938.

Experience in sanitation indicates that no one measure alone is responsible for such decreases, but that the augmented and improved health work, including control of water supplies and of milk, also share in the credit. Nevertheless, the "facts" brought out in this publication are worth consideration. Without proper waste disposal and adequate control of the quality of waters used by the people, public health is impossible. Any sound program for control of filth-borne diseases must recognize the need for furnishing safe water and adequate waste disposal to the greatest possible number.

## Pollution by Waste Sulphite Liquor in Green Bay

Green Bay, in the State of Wisconsin, receives the Fox and East rivers. Fox river receives industrial wastes from numerous pulp and paper mills, wood products plants, woolen and knitting mills, packing and rendering plants, milk factories, canneries, gas plants, and a beet sugar factory. Of the oxygen-demanding materials in the river, domestic sewage furnishes 7%, waste sulphite liquor 88%, and other wastes 5%. The State Board of Health reports that "no relief can be expected from the conditions observed in Green Bay until equipment which will remove at least the major portion of the oxygen-consuming material in waste sulphite liquor is installed at all mills discharging waste sulphite liquor into the Fox river."

It was found that there was a zone of deoxygenation in the bay which changed its location with the temperature, moving from the mouth of the river in summer to the outer bay in winter. This seasonal change is attributed to the change in the rate of B.O.D. of waste sulphite liquor, this rate being much higher at 20° C and with only a slight perceptible lag, and much lower at 0° C with a lag extending over a period of 5 to 10 days. Movement of this zone of deoxygenation out of the river into the bay in winter weather causes the lowering of the dissolved oxygen in the water under the ice to such an extent as to cause the death of the fish in this part of the lake.

## A Clamp for Aligning Pipe

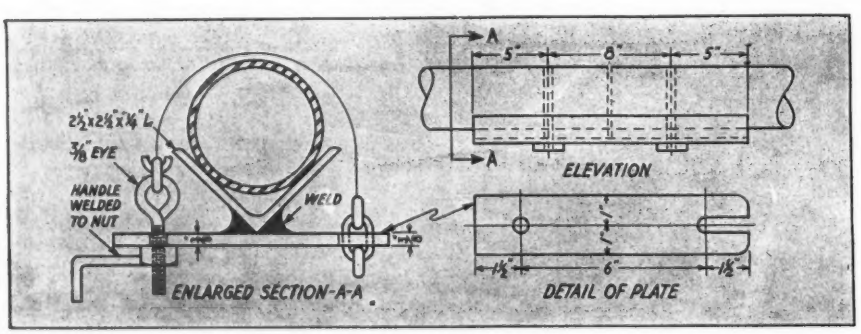
A clamp for aligning steel pipe preparatory to welding them together is described by "Oxy-Acetylene Tips" as follows:

This clamp consists primarily of two parallel plates which are connected by welding a section of angle iron sufficiently long enough to support the ends of the pipe about 6 or 8 in. back of the joint. The dimensions on the plan are for a clamp to be used on pipe up to about 3 in. diam. If larger sizes of pipe are being used, it will be necessary to increase the sizes of the angle iron, of the base plates and possibly also of the chains for holding the pipe in place.

The angle iron is first welded across the face of the two plates. The ⅜ in. eyes in each end of the plates are then inserted in the holes and the chains drawn over the pipe and slipped into the slots so that the links bear on the underside of the base plates. Nuts are threaded over the eyes. A small piece of welding rod can be welded onto each nut to form a handle for quick operation of the clamp.

It is a simple matter to adjust this clamp on the ends of two pipes. The pipes can be spaced by laying an ⅛-in. or 1/16-in. diam. welding rod across the two arms of the angle iron and butting the pipe up against it, then fastening the aligning clamp in place so that the proper space is thus provided. The welding rod can then be removed and tackwelds made on three places in the pipe circumference. A modification of this clamp involves the use of two large C-clamp members.

After the tackwelds have been made, the clamp is removed and welding proceeds.




**Detail of clamp for aligning pipe for welding**

# The Editor's Page

## Needed: Education for Better Garbage Collection and Disposal

Few things are more unsightly than the nondescript garbage containers and rubbish bundles placed along a curb to await the arrival of the collector. Few things are more unpleasant than an unclean and uncovered garbage wagon passing along the streets, frequently dripping from every joint—unless it be the average garbage dump or place where garbage is fed to hogs. And when a dump catches on fire, nothing but distance, and lots of it, lends enchantment to anything.

Rats, flies, mosquitoes, crickets and other undesirable life, as well as odors, are produced by garbage dumps. Slipshod collection methods go hand in hand with such means of getting rid of garbage. Neither should be tolerated, any more than open toilets should be permitted. The latter have been pretty well eliminated through the cooperative efforts of a number of agencies. Improper methods of garbage collection and disposal also can be eliminated if similar efforts are made.

A recent questionnaire by this magazine answered by nearly 1000 small communities showed that five times as many sewage plants were to be built as incinerators; and more swimming pools and water works improvements (including softening and iron removal) than both together.

The money is available for proper handling of garbage, from home to final disposal, but other more desired community improvements compete for it and too often win out. Cooperation on the part of health boards and officials, manufacturers and publications is needed to put garbage collection and disposal in its proper place as an important health function of the community. Each of these groups can exert influence in its own field; together they can bring about a long and urgent needed reform.

## The East's First Bio-Filters for Sewage Treatment

Last week a community in New York State voted a bond issue to construct the first of the new, streamlined, high rate filters in the east. Some of the manufacturers may quarrel with us for calling such filters "high-rate," but that term is perhaps most understandable to the average engineer.

The loading on this new plant will be about 3 pounds of B.O.D. per cubic yard of stone per day, since it is designed to treat 1 million gallons per day of sewage having a B.O.D. of 425 p.p.m. on two 80-ft. diameter filters, each 3 feet deep, and to produce an effluent having a B.O.D. and suspended solids content of less than 20 p.p.m. The plant involves recirculation, the ratio of recirculation varying with the volume of flow of sewage. Of the so-called bio-filter type, this will be, we believe, the first of its kind east of California.

The problem of designing such a plant is an interesting and difficult one. Only a few plants of this type have been built, and design practice is still fluid. Taking care of flood flows, and providing for all the contingencies that so often arise in sewage plant operation, has presented many problems. Construction is expected to start by or before April 1, and the plant is to be in operation before July 1. The results of operation will prove interesting. A description of this new plant will appear in one of the early summer issues of this magazine. In conjunction with the articles on design and construction of trickling filters, beginning in this issue, the third installment of which will cover bio-filters and aero-filters, valuable information on high rate filter design should be available.

## Traffic Blackouts More Deadly Than War

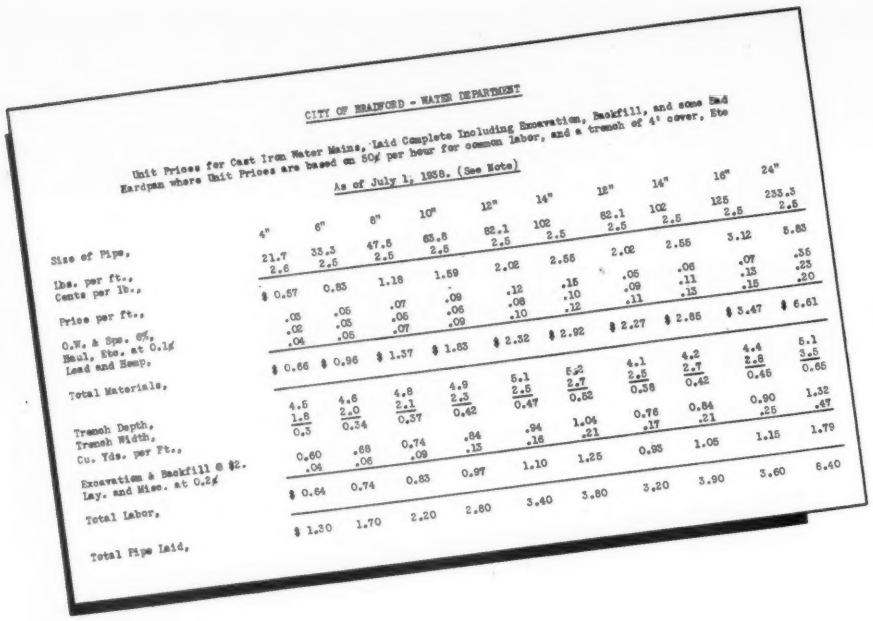
Deaths due to traffic blackouts in England are reported to be more numerous than those due to the war. In December, 1200 deaths were reported on the roads of England, and 900 of these occurred during blackouts. Birmingham was one of the cities most severely hit, with an increase of something like 80% in road deaths during the last month of 1939. Most of these deaths have been caused by pedestrians being hit by automobiles.

The experiences the countries at war are now going through have been foreshadowed by numerous records in this country of the number of accidents before and after adequate highway lighting. The reported intention of the English to place a 20-mile speed limit on automobiles within the confines of towns and cities is one method of meeting the situation, and appears to be the only one possible under war conditions.

Our safety engineers, police departments and highway engineers should study the lesson that is being given us free. They should consider such devices as are possible of incorporation in a street or highway which will minimize danger to traffic if we should ever be forced into an emergency requiring blackouts. They should also make adequate plans for handling traffic under such conditions. Previous study and consideration are invaluable and should not wait on the actual emergency.

## Housing Data to Be Collected in the New Census

Thirty-one questions will be asked occupants of each of the thirty-five million dwellings in this country in conjunction with the sixteenth decennial census which starts in April. These questions will cover the type of structure, the equipment in the house and the ownership, together with mortgage data. It is believed that the information gathered will be of value in the determination of future housing policies, and should also show trends in home ownership. Cities will be able to determine the distribution of the various types of housing within their limits, together with the number of persons in each area, thus affording data on transportation and communication needs, police and fire protection and schools.



CITY OF BRADFORD - WATER DEPARTMENT

Unit Prices for Cast Iron Water Mains, Laid Complete Including Excavation, Backfill, and some Rock Hardpan where Unit Prices are based on 60¢ per hour for common labor, and a trench of 4' cover, Etc

As of July 1, 1938. (See Note)

| | 4" | 6" | 8" | 10" | 12" | 14" | 12" | 14" | 16" | 24" |
|---|---|---|---|---|---|---|---|---|---|---|
| Size of Pipe, | 21.7 | 33.3 | 47.6 | 63.8 | 82.1 | 102 | 82.1 | 102 | 125 | 233.3 |
| Lbs. per ft., | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 |
| Cents per lb., | $ 0.57 | 0.83 | 1.18 | 1.59 | 2.02 | 2.55 | 2.02 | 2.55 | 3.12 | 5.83 |
| Price per ft., | | | | | | | | | | |
| O.W. & Spe. 6%, | .03 | .05 | .07 | .09 | .12 | .15 | .06 | .06 | .07 | .36 |
| Haul, Etc., at 0.1¢ | .02 | .05 | .06 | .06 | .08 | .10 | .09 | .11 | .13 | .23 |
| Lead and Hemp. | .04 | .05 | .07 | .09 | .10 | .12 | .11 | .15 | .15 | .20 |
| Total Materials, | $ 0.66 | $ 0.96 | $ 1.37 | $ 1.83 | $ 2.32 | $ 2.92 | $ 2.27 | $ 2.85 | $ 3.47 | $ 6.61 |
| Trench Depth, | 4.5 | 4.8 | 4.8 | 4.9 | 5.1 | 5.2 | 4.1 | 4.2 | 4.4 | 5.1 |
| Trench Width, | 1.8 | 2.0 | 2.1 | 2.3 | 2.5 | 2.7 | 2.5 | 2.7 | 2.8 | 3.5 |
| Cu. Yds. per Ft., | 0.3 | 0.34 | 0.37 | 0.42 | 0.47 | 0.62 | 0.38 | 0.42 | 0.45 | 0.66 |
| Excavation & Backfill @ $2. | 0.60 | .68 | 0.74 | .84 | .94 | 1.04 | 0.76 | 0.84 | 0.90 | 1.32 |
| Lay. and Misc. at 0.2¢ | .04 | .06 | .09 | .13 | .16 | .21 | .17 | .21 | .25 | .47 |
| Total Labor, | $ 0.64 | 0.74 | 0.83 | 0.97 | 1.10 | 1.25 | 0.93 | 1.05 | 1.15 | 1.79 |
| Total Pipe Laid, | $ 1.30 | 1.70 | 2.20 | 2.80 | 3.40 | 3.80 | 3.20 | 3.90 | 3.60 | 8.40 |

# Digging in the

KNOWING where mains, valves and fittings are, and their sizes, lengths and locations in the field is an essential in any water works plant. Even in a small community, the feet of pipe in service and the number of valves required properly to control the flow of water in them—not to mention hydrants, blow-offs and the numerous other appurtenances required—runs into large figures. In the city of Bradford, Pa., there are 215,221 lineal feet of pipe in service; 634 valves from 1-inch to 24-inch are in use; there are 5,496 lead and copper service lines, totalling 82,172.8 feet; and 325 hydrants.

Full records of all of these are maintained in the office of W. W. Lerch, clerk of the Bradford Water Department, along with a complete valuation survey of the properties of the Department made as of July 1, 1938, by The Chester Engineers, Pittsburgh, Pa.

The valuation report contains a complete table of contents, listing the many items under water diversion rights; water supply reservations; impounding reservoirs; wells; supply lines; treatment plant; pumping system, including pumping station structures, pumps, electric equipment, etc.; distribution system, including reservoirs, distribution mains, manholes, gate valves and boxes, meters and meter boxes, hydrants, land and structures; and office equipment.

The valuation report, which is too lengthy for adequate consideration here, consists of a complete summary of the entire physical property of the Department, with an estimate of the valuation of each item. Accrued depreciation is computed by the sinking fund method, using an interest rate of 4%. The totals for reproduction cost new, depreciation and present value are as follow: Reproduction cost new, $2,000,363; accrued depreciation $134,396; present value, $1,865,967. The estimated fair allowance for depreciation reserve is $9,141.51 per year.

Pipe lines are first summarized by size, from 1-inch to 24-inch. Following this are complete detailed listings of all distribution lines. These listings show for each line the following data: (a) On Street; (b) From; (c) To; (d) Date laid; (e) Laid by, as City, City-WPA, or contract; (f) Type, as B&S or Galv.; (g) Class, as 150; (h) Joint type; (i) Size; and (j) length in feet. This compilation gives the complete classification of every pipe line in every street.

Gate valves and tapping sleeves and valves are also summarized, and the summary followed by a complete list of valve locations, using the following headings: (a) On Street; (b) On or Between; (c) Size; (d) Type; and (e) Number of Valves at this location. A study of unit prices of gate valves and boxes has been made, similar to the pipe study which is shown herewith.

CITY OF BRADFORD - WATER DEPARTMENT

FIRE HYDRANTS AND BRANCHES

| W. | On Street | At or Between | Hydrant Branch Size | Length | Conn. | Valves | Hydrant Size | Make | Type |
|---|---|---|---|---|---|---|---|---|---|
| 6 | E. Main Street | N. Kendall & Leon (459) | 6" | 12' | 6x6 TS | 6"T | 3.4" | Kennedy | Pumper |
| 6 | Leon | 250' NW of E. Main | 4 | 16'10" | 4x4 T | 4 | 4 | Ludlow | |
| 6 | E. Main | Melvin | 6 | 11' | 6x6 TS | 6 T | 4 | Ludlow | |
| 6 | E. Main | 350' NW of Kendall Crk. | 4 | 9 | 6x4 T | 4 | 4.5 | Kennedy | Pumper |
| 6 | E. Main | 400' S. of Hawthorne (606) | 4 | 13 | 6x4 T | 4 | 4 | Darling | |
| 6 | E. Main | 100' N. of Hawthorne (636) | 4 | 13'3" | 6x4 T | 4 | 4 | Ludlow | |
| 6 | E. Main | 600' N. of Hawthorne (684) | 4 | 13'3" | 6x4 T | 4 | 4 | Darling | |
| 6 | E. Main | City Lime (724) | 4 | 13'3" | 6x4 T | 4 | 4 | Matthews | |
| 6 | Russell Blvd. | Case Cutlery | 6 | 9'0" | 6x6 T | 6 | 6 | Kennedy | |

# File Instead of in the Street

**How the Bradford, Pa., Water Department keeps its records and files so that full data are always available regarding "where" and "what size." Methods of valuation.**

CITY OF BRADFORD - WATER DEPARTMENT

A Detailed Listing of Distribution Pipe Lines

| On Street | From | To | Date | Laid By | Type & Class | Joint | Size | Length |
|---|---|---|---|---|---|---|---|---|
| Brook Street | Parkway Lane | Stone | | | | | 6" | 330' |
| Orchard | Stone | Bennett | 1938 | City-WPA | DeL. - 150 | Dresser | 4 | 977 |
| Calvin Court | Burk | Bennett | 1925 | City | B.& S. B | | 4 | 420 |
| " " | " | " | 1928 | " | " " | | 4 | 202 |
| Abbott | Brook | Bennett | 1925 | " | " " | | 6 | 750 |
| Winter | Center | Short | 1930 | " | " " | Hydro. | 4 | 270 |
| " | Short St. | | 1936 | City-WPA | DeL. 150 | | 4 | 94 |
| Summer | Bennett | Center | 1897 | Contract | B.& S. B | | 6 | 710 |
| " | Center | Pearl | 1897 | " | " " | | 6 | 640 |
| " | Pearl | Jackson | 1897 | " | " " | | 6 | 1180 |
| Pleasant | Brook | Bennett | 1913 | " | " " | | 6 | 520 |
| " | Bennett | Center | 1897 | " | " " | | 6 | 720 |
| " | Center | Pearl | 1897 | " | " " | | 6 | 640 |

Service lines are also listed by streets, the information in the table indicating the location, the number of services on each street, the combined length of the services, and material. In preparation for this, it was of course necessary to have a record of each individual installation on each street. A summary of service lines by material and size is given at the end of this table.

A summary of hydrants and branches is given followed by a complete description of each hydrant, as follows: (a) On Street; (b) At or Between; (c) Hydrant branch size; (d) length and (e) connection; (f) Valves; (g) Size; (h) Make of Hydrant; and (i) Type (as pumper).

In some cases, sketches have been included showing details of complicated sections of the lines at various points, as at the chlorine house below No. 2 reservoir, and the connections at the airport wells. These sketches show the pipe layouts and lengths, fittings used and sizes of pipe and fittings, and give reference points for locating these.

## Unit Prices

Unit prices have been developed for pipe, gate valves and boxes and tapping sleeves and valves. These are generally based on material prices as of July 1, 1938, with labor at 50 cents per hour, and include complete construction.

For pipe, the price is based on a trench 4 feet deep, with excavation and backfill. The headings for each size pipe are as follows: (a) Size of pipe; (b) pounds per foot of pipe; (c) price per pound of pipe; (d) resulting price per foot; (e) lead and hemp, hauling and specials; (f) a summary of total materials cost; (g) trench width; (h) trench depth; (i) cu. yds. per foot of trench; (j) excavation and backfill at $2 per yard; (k) laying, etc.; (l) a summary of total labor costs; and (m) the total cost of pipe laid. On this basis the costs per foot are estimated as follows: 4-inch, $1.30; 6-inch, $1.70; 8-inch, $2.20; 10-inch, $2.80; 12-inch, $3.40; 14-inch, $3.80; 16-inch, $4.60; and 24-inch, $8.40.

The cost of laying the pipe does not increase as rapidly as the cost of pipe itself, naturally. For the smaller pipe, as 4-inch, the labor cost is nearly one-half the total, but on the larger pipe it is only 20% to 30% of the total.

Unit costs for gate valves and boxes installed were estimated in the same general manner, resulting in total installed costs for gate valves and boxes as follows: 4-inch, $21.90; 6-inch, $32.56; 8-inch, $47.43; 10-inch, $74.50; 12-inch, $96.77; 14-inch, $136.40; 16-inch, $183.23; 18-inch, $248.72; 20-inch, $305.20; and 24-inch, $472.81. When by-passes or spur gears are used, this cost increases.

# Experiences in Placing Highway Concrete by Vibratory Methods

By F. V. REAGEL
Missouri State Highway Department, Jefferson City, Missouri

VIBRATION was first introduced into Missouri several years ago, using rather unorthodox methods and equipment. In 1937 we started the general use of vibration as an alternate method for the finishing of concrete pavements, and since then no concrete pavement projects of any size have been finished by any other method.

Our vibration alternate permits a reduction in cement content of only 0.1 barrel per batch of concrete, which amounts to a saving in material of 3c per square yard. This saving goes to the department as it is reflected in the bid price. The saving to the contractor, if any, is in reduced labor costs. Although stiffer mixes are used than under other methods, the vibrator assists the finishing machine to strike off the mass of concrete and permits the movement of larger loads which would otherwise require shoveling. We do not have available data upon which to estimate cost savings to contractors, but it is significant that the vibratory alternate controls in all competitive bidding. If the contractor is not effecting a saving, he is a victim of the development of concrete paving into more or less of an exact science and may be forced to use this method to meet competition.

Owing to varying characteristics and behavior in concrete mixes of the many combinations of materials available in Missouri, designed proportions will vary considerably. Using the more workable combinations of aggregates, such as rounded quartz sands with gravel or crushed stone, no finishing difficulties are experienced with the use of an excess mortar content of 50%. Of course, on experimental work we have obtained satisfactory results with much harsher mixes but, for the average job, which will not warrant the strict surveillance practiced on investigational projects, an additional safety factor is desired. For this reason we have established 50% as the minimum excess mortar content (volume of mortar above that required to fill the voids in the coarse aggregate divided by the volume of the voids in the coarse aggregate) for the most workable materials with increases in this figure for harsher working aggregates.

Most of this mixes could possibly be placed with a standard finishing machine but naturally with greater difficulty and added labor cost. Accordingly, we are practically certain that we are not getting the maximum benefit from this method. We have ample data to justify double the present reduction in cement factor if and when some better and more certain method of depositing the concrete is devised. Until that time, we will probably continue to maintain a relatively high mortar content to avoid the attendant evils of poor placement such as segregation.

In this connection it might also be noted that continued experience teaches us to be more critical of the consistency of the mix, as vibration tends to lose its effectiveness if the mix is either too wet or too dry. Failure to control this feature may also contribute to the scaling of oversanded mixes reported by some early authors. In general, although in a strict sense our mixes are oversanded, our observations would not support the view that scaling could be attributed to the use of this method of finishing.

As has been pointed out many times, the vibratory method can be used either to effect saving in cement or to obtain denser mixes with the same cement factor. Our designs follow the first idea with the intention of maintaining only the equivalent strength characteristics which could be obtained by the alternate method.

The strength of beams on nonvibrated work has averaged approximately 620 lb. per square inch at 3 days age and 750 lb. per square inch at 7 days as compared to 640 lb. and 790 lb. per square inch for vibrated concrete at the same ages. This slight increase is hardly significant as it could have been the result of seasonal variation.

Two general types of equipment are being used satisfactorily on our work—the surface application type and the internal type, so called. At present, the tendency of contractors seems to be to prefer the internal type probably because of the lower first cost.

To sum up our situation, we conclude that the vibratory method of finish has practically eliminated competition where permitted as an alternate; that it is producing a satisfactory product at a cost attractive to contractors; but that full advantage cannot yet be taken of the method because of lack of needed development in the method of depositing the concrete to be vibrated. (This is an abstract of a paper by Mr. Reagel at the recent ARBA meeting.)

## Blast Furnace Slag and Bitumen

The author reviews the uses of blast furnace slag in the different types of road surfacing, with numerous bibliographical references. Chippings derived from this type of slag can be sucecssfully used in surface dressings. In the case of penetration asphalt macadam surfacings, the most satisfactory results are obtained where the base course consists of as coarse an aggregate as possible, which should be rolled lightly before the application of the binder. Where the depth of the base course exceeds 3 in. it should be covered before rolling with chippings (0.2 to 0.8 in.), which should be brushed into the interstices. After an application of bitumen or bitumen emulsion the surface should again be covered with 0.2 to 0.8-in. chippings and rolled. A sealing coat of bitumen should then be applied and sprinkled with 0.2 to 0.3 or 0.5 to 0.7-in. chippings according to the texture desired in the finished surfacing.

Blast furnace slag is particularly suitable as aggregate in this type of surfacing as it absorbs the binder readily and holds it over a considerable period. Provided that good quality material only is employed, that the slag is not unduly crushed during rolling and that binders of fairly high viscosity are used, surfacings containing slag as aggregate should retain their non-skid quality longer than those containing natural stone. Increasing use is being made in the upper

courses of pre-mixed asphalt macadam surfacings of aggregate precoated with bitumen, even where aggregate precoated with tar or cut-back bitumen is used in the binder course. The aggregate is used in gradings of 0.4 to 1.0-in. and 0 to 0.2, 0 to 0.4, 0.1 to 0.32 or 0.12 to 0.6 for the intermediate and wearing course respectively. A sealing coat consisting of bitumen-coated sand derived from slag is applied at the rate of 7.36 lb./sq. yd. Satisfactory use has been made of cut-back bitumen as a binder in this type of surfacing; it enables surfacings to be laid as late in the year as November or December. Such surfacings are satisfactorily non-skid and require little maintenance.

In the construction of surfacings of the *Einstreudecke* type, slag chippings precoated with cut-back bitumen are applied at the rate of 57 and 46 lb./sq. yd. for the base course and wearing course respectively, the respective gradings of aggregate for the two courses being 0.2 to 0.6 in. and 0.12 to 0.32 in. The wearing course is usually covered with 18 lb./sq. yd. of chippings (0 to 0.12 in.) An increasing tendency is observable to omit the surface dressing of "Einstreudecke" surfacings and thin carpets, if the wearing course contains bitumen-coated aggregate. Slag may be used as aggregate in asphaltic concrete surfacings as good results being obtained as with natural stone provided that the proportion of binder employed is reduced to a minimum.

Powdered slag may be used as filler and its stabilizing properties are stated to be superior to those of limestone or cement. Aggregate derived from blast-furnace slag has been used successfully in Dammann asphalt surfacings, this being chiefly due to the cubical shape of the particles and their rough surface. In sand-asphalt surfacings care should be taken that the sand is derived only from carefully selected, twice-broken slag. In such cases satisfactory results can be obtained, the resulting surfacing having a better non-skid quality and a greater resistance to wear than surfacings containing quartz sand. It has been found that a higher degree of compaction can be obtained with a mixture containing 90 per cent of sand derived from blastfurnace slag and 10 per cent of powdered limestone than with sand alone. A graph shows suggested gradings of sand for sand-asphalt surfaces.—T. TEMME: *Bitumen,* 1939, **9** (4), 68-74. *Road Abstracts.*

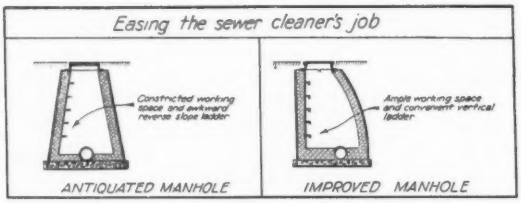
## Fine Financial Standing of Lorain's Water Department

"During the depression we have not only paid cash for all extensions but also have reduced the bonded indebtedness of the Water Works Department from $597,000 to $127,000 and the total will be definitely clear by 1943. No bonds have been issued, no notes have been given on any extension program in the last fifteen years." That is the unusual record of the Water Works Department of Lorain, Ohio.

Last year that department laid approximately 3½ miles of mains, most of which was 6", and this year is laying approximately 4 miles, mostly 12" and 18". This will make approximately 120 miles of mains, on which are about 800 fire hydrants, 18 of which were set in 1938 and 30 this year.

This year it is finishing a program which covers the revamping of the boilers, the installation of a 7.5 mgd steam turbine centrifugal pumping unit, and construction of a 405 ft. tunnel under the river with two 60 ft. shafts. The cost of this program will be about $125,000. It is a PWA project and the department's share is being paid in cash derived solely from income.

# Water and Sewage Kinks and Details




**A hint regarding manhole design to facilitate the sewer cleaner's job. From "Pipe Lines," published by Clay Sewer Pipe Assn.**

## Lining Pasadena's New Reservoir

Pasadena, Calif., in 1916 built a 7 m.g. reservoir known as the Sheldon reservoir. Since then the area served has more than doubled and the maximum daily demand has increased over four times. Last year the city built a 5,200,000 gal. addition to this reservoir, so connected with it that the two units can be operated either separately or as one reservoir.

The reservoir was constructed with earth banks compacted in 4-inch layers. The inside section of the banks for a depth of four feet and the bottom of the reservoir for a depth of two feet was mixed with road oil and then compacted. Upon this prepared sub-base, a six-inch reinforced concrete lining was laid. The reservoir roof was built of creosoted Douglas fir timber, supported on redwood posts and covered with corrugated galvanized steel sheeting. The outside slopes of the reservoir banks were planted to native flowering shrubs, which are making an attractive showing. In time, the planting will entirely hide the reservoir structure from view.

The total contract cost of the construction was $76,296.47, of which the PWA contributed $37,878.35.

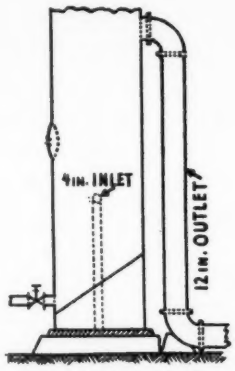
## Prize-Winning Papers on Value of Attendance at AWWA Convention

A contest, sponsored by Industrial Chemical Sales Division, on "What attendance at the Annual Meeting of the American Water Works Association has meant to me" brought out a number of excellent papers. Prize winners are as follows: First, W. V. Weir, St. Louis County Water Co., University City, Mo.; second, R. L. Dobbin, Peterborough Utilities Commission, Peterborough, Canada; third, A. R. Todd, Chemist and Superintendent of Purification, Wheeling, W. Va.

## Tank Details for a Warm Climate

Los Angeles, Calif., last year built an elevated water tank for use in connection with its new union railroad terminal that has two rather novel features, both in connection with the riser.

The riser is of welded steel 48" diameter. The connection between it and the piping system is not made to the under side of the bottom plate, but is made by means of a 12" pipe connected to the side of the riser 14 ft. above the base. This construction, says "The Water Tower" (Chicago Bridge & Iron Co. house organ) "can be used in warm climates where it is not necessary to have a hollow center pier and make the piping connections through the base of the riser."




**Sketch of riser pipe connections**

The other feature referred to is an arrangement for cleaning settlings from the bottom of the riser. The bottom of the riser is placed a short distance above the base and on a 30° angle with the horizontal. A 4" inlet pipe is connected to the outside of the riser 6 ft. above the base, and a blow-off pipe at the low point of the bottom plate. Water for flushing out the riser is admitted through the 4" inlet.

## Sewage Per Capita for Different Units

The State Water Commission of Connecticut, which is in charge of the State's effort to reduce pollution of its streams and therefore to secure treatment of sewage throughout the State, has published the accompanying figures of volume of sewage to be provided for by cities and smaller units, as being fairly representative of conditions in that State.

**NUMBER OF GALLONS OF SEWAGE PRODUCED PER CAPITA PER DAY**

| *Source of Sewage* | *Volume of Sewage per Capita per 24 Hrs. Average* | *Maximum* | *Minimum* |
|---|---|---|---|
| Grade schools | 5 | 10 | 3 |
| High schools with showers | 12 | 15 | 8 |
| Farms | 10 | 20 | 6 |
| Modern 5-room houses | 30 | 60 | 15 |
| Apartments high class | 65 | 125 | 30 |
| Hotels, first class | 70 | 100 | 50 |
| City, average residential | 110 | 150 | 90 |
| City. commercial—small stores. | 40 | 60 | 30 |
| City, factory | 20 | 30 | 15 |
| State institutional | 145 | 225 | 60 |

## American Water Works Association

The nominating committee of the American Water Works Association has selected the following nominees: For president, Norman J. Howard, Director of Water Purification, Toronto, Ontario; vice-president, Louis R. Howson, consulting engineer, Chicago, Ill. W. W. Brush is nominated to succeed himself as treasurer.

Honorary memberships were awarded to George H. Fenkell, Almont, Mich., former general manager of the Board of Water Commissioners of Detroit, Mich.; James E. Gibson, manager and engineer of the Water Department, Charleston, S. C.; John A. Kienle, vice-president, Mathieson Alkali Works, N. Y.; and Herbert M. Lofton, founder and general manager of the Columbian Iron Works, Chattanooga, Tenn.

The Diven medal for 1940 was awarded to W. V. Weir of the St. Louis County Water Co.; The John M. Goodell prize went to Thomas H. Wiggin, consulting engineer of New York, and Melvin L. Enger, dean of engineering, University of Illinois, for their paper on "A proposed new method for determining the barrel thickness of cast iron pipe."

Membership increased from 3359 to 3710 during 1939—the largest increase of record. The Kansas City convention will be held April 21 to 25.


# New DIESEL TRACTRACTORS by INTERNATIONAL HARVESTER

A YEAR AGO we announced the big, powerful TD-18 TracTracTor, a new top for Diesel crawlers. Today International Harvester presents a rugged quartet of streamlined crawlers —TD-18, TD-14, TD-9 and TD-6. FOUR *Diesel TracTracTors for 1940*—big news from the world's leading tractor builder to *all* operators of crawler tractors!

Here's the complete line-up for you to look over—the big fellow at the right, already a popular favorite in the heavy-crawler field; his little brother at the far left; and the step-ups in between. There's not an ounce of lazy horsepower in any of them! They're ready to tackle their weight in wildcats—each one is ready to lick the crawler-power problems in his range!

In this complete series of TracTracTors, INTERNATIONAL offers you a new standard of Diesel performance and economy—perfectly designed balanced power in capacities to meet every demand of crawler-tractor users. Standardize on International and enjoy all the advantages only Harvester can provide. Get the full story from any International industrial power dealer or Company branch, or write us.

*A great variety of specially designed allied equipment available for all TracTracTor sizes.*

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(INCORPORATED)
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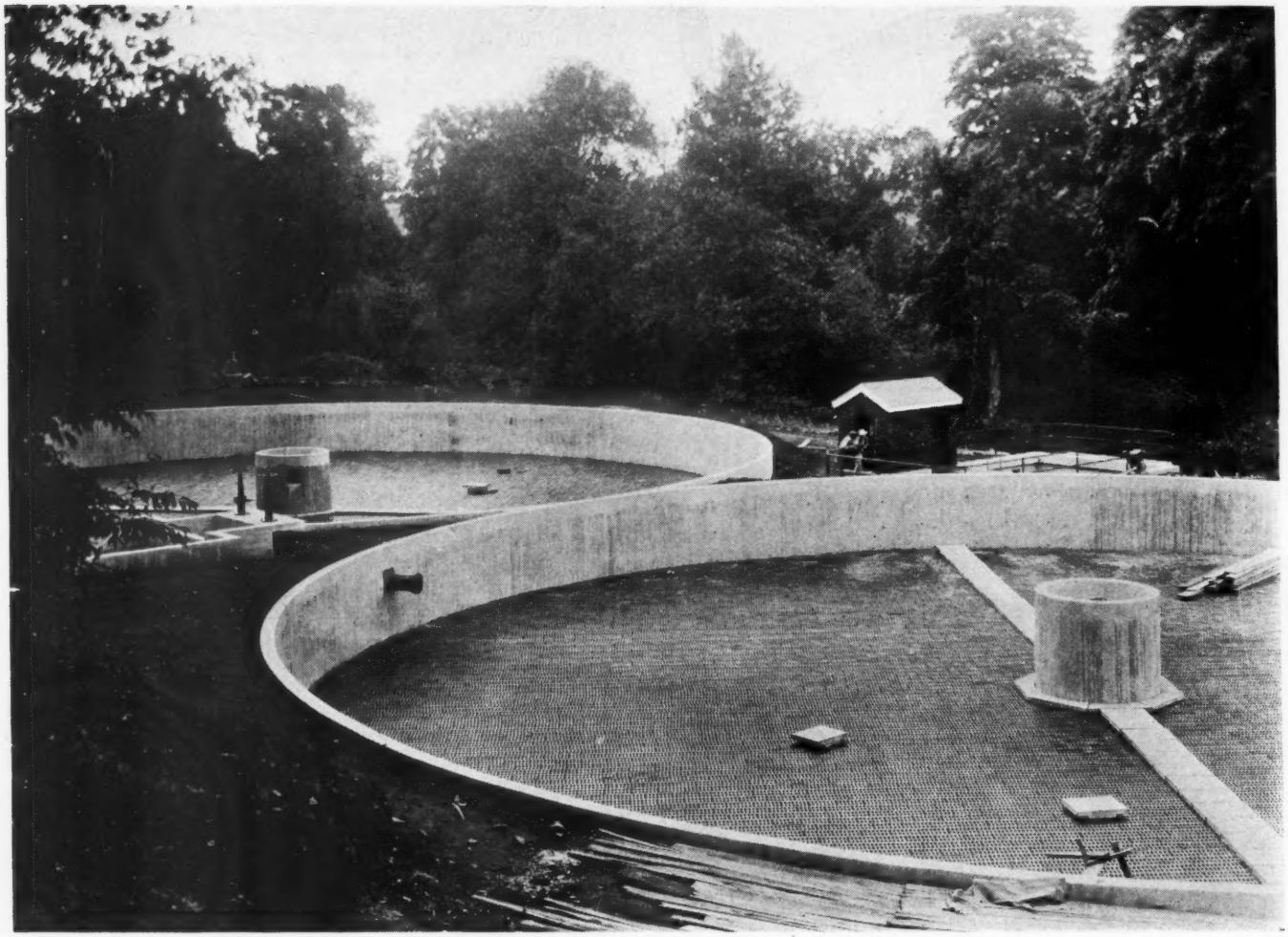
Now 4 Sizes



Two 120-ft. trickling filters for Brazil, Ind., designed by Caldwell Engineering Co., showing underdrainage.

# TRICKLING FILTERS—Their Design,

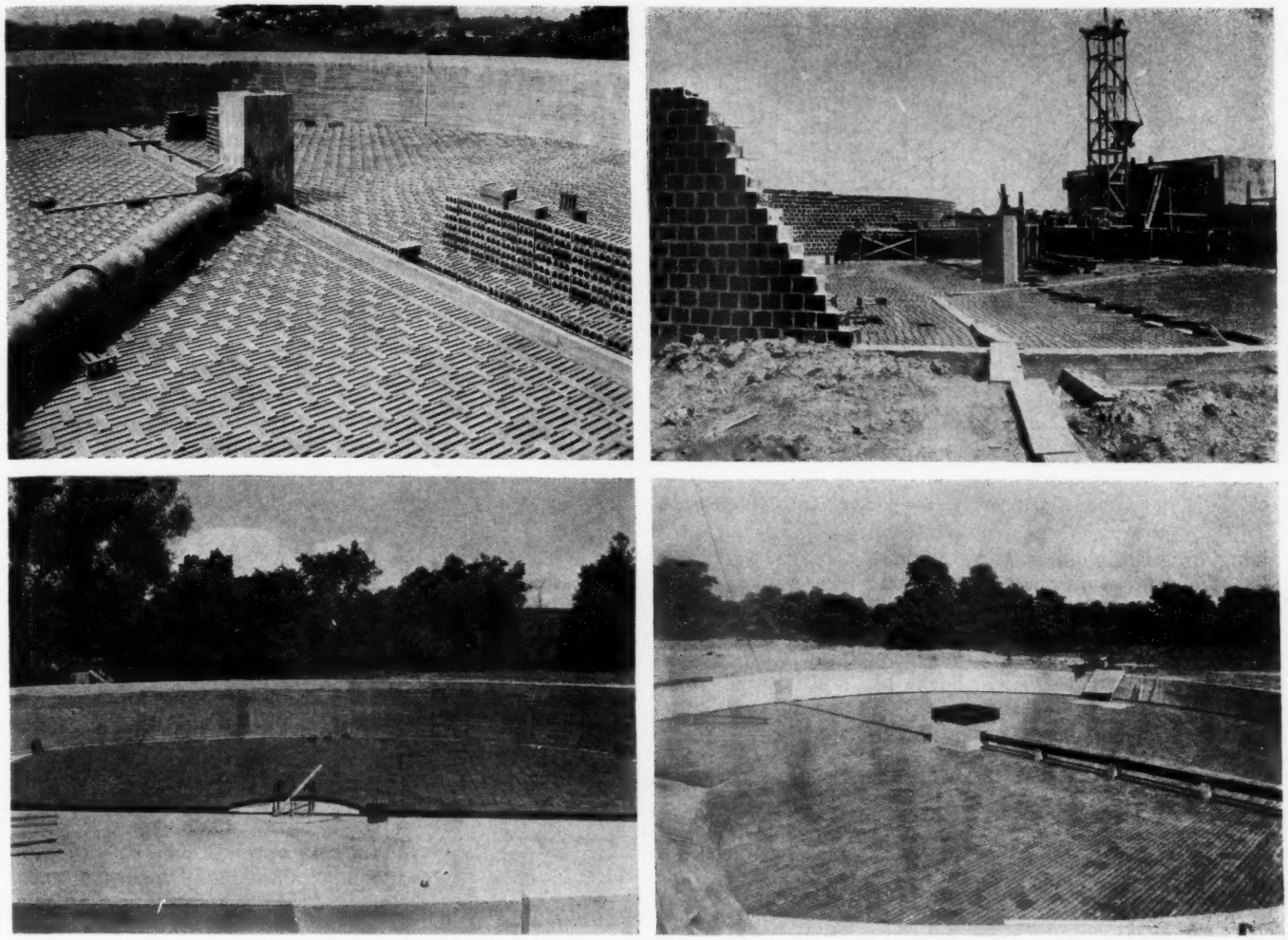
**The first of a series of articles, prepared by the editors of Public Works, discussing and explaining factors in the design, construction and operation of trickling filters, both standard and high-rate.**

OF ALL devices developed for the treatment of sewage, no other has had such a long life of general effective service as the trickling filter. Even now, some forty years after its introduction, it is still used more generally than all other secondary treatment devices combined, and essentially in its original form. Recently, engineers and scientists have developed new possibilities in the trickling filter, which have brought it into greater prominence and extended the already broad field of its usefulness. Notable among these improvements have been the great increase in the rate of operation and the better results attained. As a result, trickling filters are now adapted to use where effluents with a high degree of organic reduction are required, in addition to their general use in secondary treatment.

This time, therefore, seems most appropriate to review the fundamentals of the trickling filter and to discuss its later developments. The series of articles, of which this is the first, will cover designing, construction and operating trickling filters, both standard rate and high rate, with rotary distributors and with fixed nozzles. In general, because rotary distributors have proved so efficient that they are now used in the great majority of new installations, they will be considered as standard.

There are certain fundamental differences between standard-rate and high-rate trickling filters which preclude treating them jointly; moreover, a thorough knowledge of the fundamentals of the standard-rate filter is a necessary preliminary to discussion of high-rate filters. Therefore, the first portion of this series will be devoted to standard-rate filters and the second portion to high-rate filters. In general, trickling filters which are operated without recirculation will be classed as standard-rate filters, irrespective of the rate at which the sewage is applied to them.

The headings in these articles will include: Filter loadings and volume of applied sewage; pretreatment; design details, including shape, walls, floor, underdrainage, ventilation, piping, siphons and provision for fly and odor control; filter media; distributing equipment; costs and operation proce-



**A group of trickling filter installations. Fuller data on each is given below.**

# Construction and Operation

**The pictures above: Upper left, Lancaster, O., plant, Burgess & Niple, engineers; upper right, hollow tile walls for Crowley, La., plant, L. J. Voorhies, engr.; lower left, part of floor in place; lower right, Ashland, O., plant.**

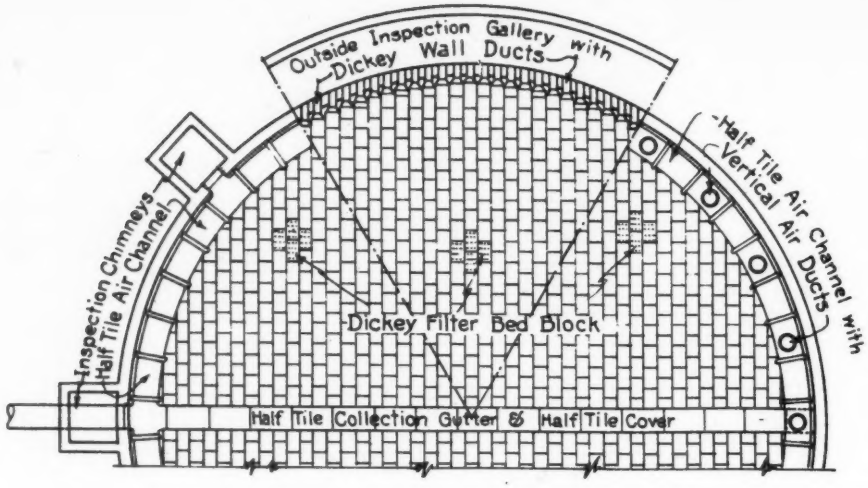
dure. Essentially the same factors will be covered, eliminating unnecessary duplication, for both standard rate and high rate filters.

## List of Common Abbreviations Used

In sewage treatment, a number of abbreviations are commonly used, as a matter of convenience. Among them are: *Af* for acre-foot, which is one acre of 43,560 sq. ft. one foot deep, equivalent to 43,560 cubic feet; *cf* represents cubic feet; *cfs* represents a flow of cubic feet per second; *mgd* is the condensation for millions of gallons per day; *mgad* means millions of gallons per acre per day; *gpm* represents gallons per minute; *gph* is gallons per hour; *BOD* is the contraction for Biochemical Oxygen Demand and is the measure of organic matter in the sewage, or of the strength of the sewage; usually BOD is stated in parts per million, or *ppm.;* since a gallon of water or sewage weighs 8.33 pounds, 1 ppm. equals 8.33 pounds per million gallons; *relative stability* is also a measure of the decomposable organic matter in the sewage, determined by simpler methods than BOD, and with results that are not closely comparable.

## How the Trickling Filter Works

THE trickling filter is an oxidizing device, the function of which is to obtain more or less complete oxidation of the organic matter in the sewage applied to it. The filter consists of a bed of broken stone, usually 1½ to 2½-inch particles, and is ordinarily 6 to 8 feet deep. The sewage is applied intermittently as a spray or in thin sheets to the surface of the bed, and trickles down through the stone to the underdrains beneath, where it is collected and discharged through an outlet channel. A bed composed of such large stone particles will not, of course, strain out the suspended matter or other impurities in the sewage (although some of it collects on their surfaces by adsorption); instead, purification is effected by the organic coating which forms on the surface of the stone particles. As the sewage flows in very thin films over the organic coating on the stone, oxi-




**A part plan of a typical underdrain installation.**

dizing bacteria in this coating accomplish the process of oxidation, air in the interstices of the bed providing the necessary oxygen.

If we assume a filter media of 2-inch spheres forming a bed 6 feet deep, to which sewage is applied at the rate of 1 million gallons per acre per day, the thickness of the film of sewage passing over the spheres will average about 0.008 inch, if it requires 1 hour for the sewage to pass through the bed. Actually, a less time is ordinarily required for passage through the filter, but the illustration serves to show the extreme thinness of the films of sewage.

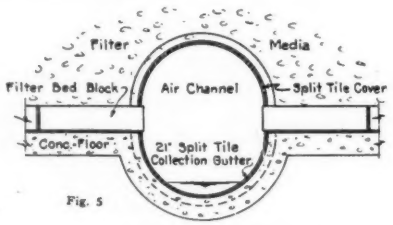
In order to function at the maximum of efficiency, every cubic foot of the filter media should oxidize the greatest possible amount of organic matter. This requires that: (1) The filter media be uniform throughout; (2) the distribution of sewage over the entire bed be uniform; (3) that every cubic foot of the filter bed contain ample air for furnishing the necessary oxygen.

Standard rate trickling filters, when preceded by adequate primary treatment and followed by secondary settling, will accomplish from 85% to 90% reduction in the organic matter in the sewage—in some cases even more. In general, the effluent from a trickling filter should not contain more than 40 p.p.m. of B.O.D. or of suspended solids; in many cases, even better results will be obtained, much depending upon such local conditions and the strength and character of the sewage.

## Importance of Ventilation

Since the entire process is aerobic, the presence of air continuously in all the interstices of the bed is necessary. With the early type of filter, with application by spraying from fixed nozzles, some dissolved oxygen was taken up from the air during the spraying process. With the more direct application of the sewage from rotary distributors, it is questionable if the oxygen absorbed during distribution is important. Most or all of the air required for and utilized in oxidation must be provided by so-called ventilation—movement into the bed from the air above downward, or from the drains upward. Experiments have appeared to demonstrate that the direction of this movement depends largely upon the relative temperatures of the sewage and the air, and upon atmospheric pressures.

Only part of the air in the interstices of the filter bed contributes its oxygen to the functioning of the filter. How much is required is not definitely known, and the total amount of air that should pass into the filter to give maximum efficiency in operation has been determined largely by observation and experience in operation. Good design should provide the fullest opportunity for ample air to enter the underdrainage system and to pass into and through the filter bed.




SECTION THRU GUTTER

Distribution of the air to all parts of the filter is very important. Given openings from air ducts to filter bottoms of such dimensions that they are not liable to be clogged by suspended solids in the filtrate (as during filter unloading) or by biological growths along their edges, it is believed that the greater the number of these openings, distributed uniformly, the more complete will be the "ventilation" of this filter and the oxidation effected.

## Pre-Treatment

To be readily oxidizable, the organic matter not in solution should be finely comminuted or colloidal. Moreover, sewage containing larger particles of matter suspended are difficult to apply through the customary distributing devices, and these particles would be apt to clog the surface of the filter. Therefore raw sewage is rarely if ever applied to a filter, but is prepared for filtration by some pre-treatment.

The customary method of pre-treatment is to first pass the sewage through screens or through a comminuter and then into a tank where it is allowed to settle to remove the greater part of the settleable solids. This pre-treatment not only removes matter which is likely to clog the filter or its distributing system, but it also reduces the organic load on the filter.

A sedimentation period of at least two hours should be provided for the raw sewage; three hours is usually preferable. General practice is to design for 2 hours or more sedimentation on the basis of the estimated probable flow ten to twenty years hence. This involves predicting the growth of population and of sewage flows. If the present flow is 400,000 gpd, and it appears from a study of local conditions that a flow of 600,000 gallons may reasonably be expected in 15 years, the plant should be designed for the larger amount. Sedimentation facilities would then be designed as follows: Detention period 2 hours; flow 600,000 gpd; tank capacity 600,000 x 2 ÷ 24 = 50,000 gallons or 6,000 cubic feet. With a water depth of 8 feet, the surface area of the tank would be 750 sq. ft. This might be provided by a single tank either round (31-ft. diameter) or rectangular (say 10 x 75 or 15 x 50) or by two tanks, either round or rectangular.

Septic tanks are not used except for small installations; one reason is that they do not provide as efficient treatment, and another is the greater offensiveness of the odors given off by the gases that escape during the process of applying the sewage to the filter. The plain sedimentation tank, with sludge collecting equipment and separate sludge digestion has many advantages; but for flows less than 200,000 or 300,000 gpd Imhoff or septic tanks are often used.

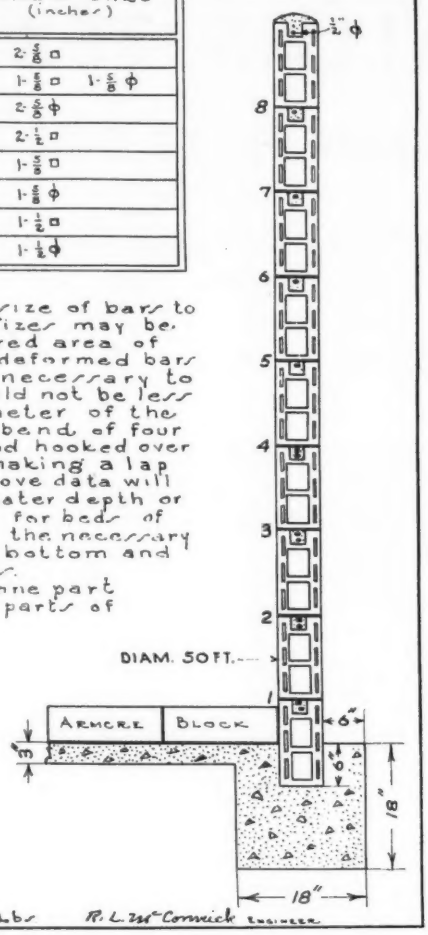
Well designed and properly operated sedimentation tanks may be expected to remove around 50% of the suspended solids and somewhat less of the B.O.D. A raw sewage that contains 250 p.p.m. of B.O.D. will have a B.O.D. of perhaps 125 to 150 p.p.m. after adequate settling. If settling is accelerated and improved by chemical coagulation, B.O.D. reduction may be 70% to 80%:

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 63 to 65.

SHOWING USE OF ARMCRE VITRIFIED FIRE CLAY BLOCKS, REINFORCED, FOR ROUND TRICKLING FILTER BED WALLS.

| JOINT | DEPTH | TENSION (Lbs.) | STEEL AREA (Sq.in.) | SIZE OF BARS (inches) |
|---|---|---|---|---|
| 1 | 8'- 0" | 12500 | .78 | 2-⅝ □ |
| 2 | 7'- 0" | 10940 | .68 | 1-⅝ □ 1-⅝ ϕ |
| 3 | 6'- 0" | 9380 | .59 | 2-⅝ ϕ |
| 4 | 5'- 0" | 7810 | .49 | 2-½ □ |
| 5 | 4'- 0" | 6250 | .39 | 1-⅝ □ |
| 6 | 3'- 0" | 4690 | .29 | 1-⅝ ϕ |
| 7 | 2'- 0" | 3130 | .20 | 1-½ □ |
| 8 | 1'- 0" | 1560 | .10 | 1-½ ϕ |

The above table shows the size of bars to be placed in each joint. Sizes may be changed provided the required area of steel is maintained. Use deformed bars for reinforcement. When necessary to splice bars the lap should not be less than forty times the diameter of the bars, or a semicircular bend of four diameters can be made and hooked over the end of a block thus making a lap of twelve inches. The above data will not be safe for beds of greater depth or diameter, but may be used for beds of smaller depth by taking off the necessary number of courses at the bottom and using the same footings. Mortar shall consist of one part Portland cement and two parts of clean, sharp, fine sand




Wt. of steel for one bed: 21001bs R. L. McCormick Engineer

that is, the tank effluent may contain only 50 to 75 p.p.m. of B.O.D.

The lower the B.O.D. in the effluent applied to the filter, the lower is the final B.O.D. obtained in the filter effluent; also the smaller is the volume of filter required if this is based on the B.O.D. load per cubic yard. Reduction in suspended matter also reduces probability of filter clogging. In some plants screens, with mesh not greater than ¼ inch, are placed ahead of the filter to remove any particles that might clog the distributing orifices.

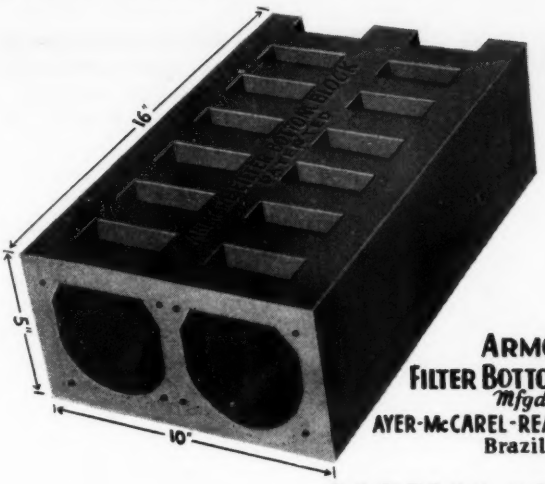
The filter effluent also must be settled, as some particles of organic matter are carried out of the filter—in considerable quantities during the unloading periods. Design of post treatment units will be discussed later.

*Pre-Aeration.*—In some cases the settled effluent is pre-aerated before application to the filter, whereby some oxidation takes place beforehand and the sewage may contain free oxygen to supplement that which is supplied by the filter. This is especially advantageous when the sewage is unusually stale, strong, or otherwise has high oxygen demand; or for relieving an overloaded filter until such time as the plant's filter capacity can be increased. Unless compressed air is required for other purposes at the plant, however, equivalent final results ordinarily can be secured at less cost by increasing the size of the filter plant.

Pre-treatment by activated sludge is a recognized practice in England, by which both flocculation of colloids and pre-aeration are obtained.

## Designing Standard Filters

In the design of trickling filters, the first step is the computations to determine the volume of stone needed. From the volume, by assuming a depth (which may be determined or influenced by local considerations), the required area is determined. The *number* of filter units required depends principally upon the required area of the filter, but also on the volume of average, maximum and minimum flows and on other local conditions. When the size, depth and number of units have been decided on, the designer proceeds to work out the details of the various parts of the plant; that is, the design




ARMCRE
FILTER BOTTOM BLOCK
*Mfgd by*
AYER-McCAREL-REAGAN CLAY CO.
Brazil, Ind.

# OUTSTANDING!

## ARMCRE FILTER BOTTOM BLOCKS

**Manufactured from the best grade of de-aired fire clay, vitrified, salt glazed and used for underdrainage of sewage and waste treatment plants of the Trickling Filter Type. A product of proven merit and established worth as evidenced by the list of engineers and installations below.**

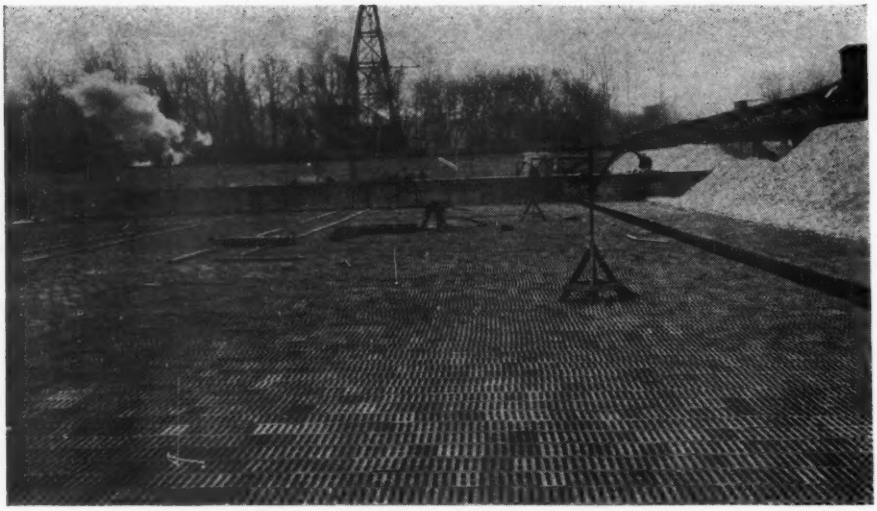
***Write for literature***

## PARTIAL LIST OF INSTALLATIONS

| *Location* | *Engineer* | *Contractor* |
|---|---|---|
| **ARKANSAS** | | |
| Fayetteville | E. M. Ratliff | McGeorge Constr. Co. |
| **ILLINOIS** | | |
| Glen Ellyn | Wells Engr. Co. | Jacobsen Brothers |
| Abingdon | Wells Engr. Co. | Gjellefald Constr. Co. |
| Sullivan | Wood, Walraven & Tilly | Sullivan Concrete Works |
| Effingham | Caldwell Engr. Co. | H. A. Grabbe Constr. Co. |
| Olney | Thos. T. Hardman | H. A. Grabbe Constr. Co. |
| Litchfield | Wood, Walraven & Tilly | Gjellefald Constr. Co. |
| Illinois Masonic Home | Wood, Walraven & Tilly | Hagerman & Harshman |
| Pontiac | J. J. Woltmann | Mackie-Thompson-Tamm Inc. |
| Algonquin | Suhr, Berryman, Peterson & Suhr | A. L. Jackson Co. |
| Hillsboro | Warren & VanPraag | Jesse C. Bremer |
| Clinton | Greeley & Hansen | Adams Constr. Co. |
| O'Fallon | Russell & Axon | Gjellefald Constr. Co. |
| Techney | Consoer-Townsend & Quinlan | Private |
| Anna | Warren & VanPragg | Gjellefald Constr. Co. |
| Casey | Russell & Axon | J. W. Etchison |
| Charleston | Russell & Axon | Gjellefald Constr. Co. |
| Benton | Maar-Green-Opper, & Assoc. Geo. Anderson | G. E. Tillman |
| Paris | Warren & VanPraag | City WPA Labor |
| New Athens | | Village WPA Labor |
| Aledo | Warren & VanPraag | Gjellefald Constr. Co. |
| Momence | McCoy & Mulford | A. C. Rehm |
| Pleasant Hill | Government Engr. | WPA |
| Marshall | Warren & VanPraag | A. H. Stiel, Inc. |
| Marengo | Victor H. Kasser | The Shurtleff Co. |
| Thornton | Edwin Hancock Engr. Co. | Village |
| Forrest | Warren & VanPraag | Gjellefald Constr. Co. |
| Wilmington | McCoy & Mulford | E. H. Swenson |
| Crystal Lake | Industrial | National Grain Yeast Corp. |
| Carlyle | Caldwell Engr. Co. | Keeley Bros. Constr. Co. |
| Taylorville | J. W. DeBrun, Jr. | Village |
| Wauconda | Jas. Anderson Co. | Darrow & Barron |
| Shawneetown | T. J. Prendergast | W.P.A. |
| Teutopolis | Warren & VanPraag | W.P.A. |
| Bluffs | Government Engr. Co. | W.P.A. |
| Hebron | Victor H. Kasser | Hebron Lumber Co. |
| Alexis | Austin Engr. Co. | W.P.A. |
| Fairfield | Russell & Axon | G. E. Tillman |
| **INDIANA** | | |
| Huntington | Charles H. Hurd | R. McCalman, Inc. |
| Union City | Charles H. Hurd | PWA Labor |
| Angola | Charles H. Hurd | T. A. & J. R. Moynahan |
| Bloomington | Charles H. Hurd | T. A. & J. R. Moynahan |
| Winchester | Charles H. Hurd | R. McCalman, Inc. |
| Danville | Charles H. Hurd | R. McCalman, Inc. |
| Princeton | Finch & Babcock | Gjellefald Constr. Co. |
| Lebanon | Jeup & Moore | R. McCalman, Inc. |
| Greensburg | John W. Moore & Son | PWA Labor |
| Butlerville | Chas. Brossman | A. E. Hutton |
| Claremont | Jeup & Moore | M. L. Oberholtzer |
| Tipton | Bevington & Williams | Ted McKinney |
| Kokomo | Russell B. Moore, Inc. | F. K. Vaughn Bldg. Co. |
| Mitchell | Charles H. Hurd | Thompson Constr. Co. |
| Franklin | Chas. Brossman | Buesching Bros. Constr. Co. |
| Bluffton | Charles H. Hurd | James A. Crosbie |
| Hagerstown | Lenox & Mathews | Wm. E. Mick, Inc. |
| Indiana Boys School | Chas. Brossman | Private |
| LaPorte | Russell B. Moore, Inc. | R. C. Witter & Sons |
| Lawrenceburg | Chas. Brossman | Wm. E. Mick, Inc. |
| Ladoga | John W. Moore & Son | WPA |
| Henry Co. Hospital, New Castle | W. H. Sorrell, Co. Engr. | Private |
| Salem | Russell B. Moore, Inc. | Thompson Constr. Co. |
| Linton | Lewis B. Finch | City WPA Labor |
| Kendallville | Charles H. Hurd | Jas. I. Barnes Constr. Co. |
| Edinburg | Charles H. Hurd | H. & F. H. Hosea Co. |
| Oakland City | Thos. T. Hardman | WPA |
| Oldenburg | Government Engr. | WPA |
| Cloverdale | Lee Engr. Co. | Town |
| Terre Haute, Federal Penitentiary | Alfred Hopkins & Asso. | Great Lakes Constr. Co. |
| **IOWA** | | |
| Decorah | Currie Engr. Co. | A. R. Coffen |
| Waterloo | C. T. Wilson | Dobson & Robinson |
| Cherokee | Buell & Winters Engr. Co. | Holtze Constr. Co. |
| **KENTUCKY** | | |
| Nazareth | School Engineer | Private Work |
| Hopkinsville | V. V. Long & Co. | Cole & Moore |
| Catholic Orphanage, Anchorage | D. X. Murphy & Bro. | Koenig Brothers |
| Versailles | Howard K. Bell | Knight Engr. Co. |
| Campbellsville | Howard K. Bell | City WPA Labor |
| Shelbyville | J. S. Watkins | Jas. G. Exterkamp & Harry Miller, Associates |
| Midway | Howard K. Bell | Clarke, Stewart & Wood Co. |
| Paris | Howard K. Bell | Clarke, Stewart & Wood Co. |
| Stanford | Howard K. Bell | Frye Engr. Co. |
| Ashland-Fed. Penitent'ry | Jesse M. Shelton | Great Lakes Constr. Co. |
| Springfield | Howard K. Bell | Clarke, Stewart & Wood Co. |
| Hodgenville | Government Engr. | WPA |
| **MICHIGAN** | | |
| Midland | Dow Chemical Co. | Private |
| **MINNESOTA** | | |
| Moorehead | Buell & Winters | Barnett Record Co. |
| Nopeming | Charles Foster | R. J. MacLeod & Co. |
| Tracy | P. C. Bettenburg, Inc. | Leck Constr. Co. |
| South Hibbing | Charles Foster | E. W. Coons Co., Inc. |
| Austin | Greeley & Hansen | McGough Bros. |
| Wayzata | Druar & Milinowski | Barnett & Record |
| Stewartville | Druar & Milinowski | L. W. Feller Co. |
| New Richland | Druar & Milinowski | C. G. Victorson |
| South St. Paul | Consoer-Townsend & Quinlan | Okes Constr. Co. |
| **MISSOURI** | | |
| Lake of the Ozarks, Kaiser | Government Engr. | WPA |
| Rolla | Russell & Axon | Dunbar & Simon |
| **NEW JERSEY** | | |
| Medford Lakes | Remington & Goff | WPA |
| **NEW MEXICO** | | |
| Albuquerque | | Bradbury & Marchant |
| **NORTH DAKOTA** | | |
| West Fargo | Alvord, Burdick & Howsen | Melnecke & Johnson (For Armour & Co.) |
| **OHIO** | | |
| Mt. Healthy | J. S. Raffety | H. & F. H. Hosea |
| Glendale | J. S. Raffety | H. & F. H. Hosea |
| Bowling Green | Smith & Niles | Bever & Morris, Inc. |
| Hicksville | Burgess & Niple | Buesching Brothers |
| Greenville | H. P. Jones & Co. | L. C. Love |
| Georgetown | Burgess & Niple | L. C. Love |
| Columbus Grove | Floyd G. Browne | Bever & Morris, Inc. |
| Coldwater, Ohio | Pet Milk Company | Private |
| Osborne | F. J. Cellarius Engr. Co. | Village WPA Labor |
| So. Charleston | Burgess & Niple | Village WPA Labor |
| Wauseon | Champ-Finkbeiner & Assoc. | Marra & Sons Constr. Co. |
| Tipp City | Burgess & Niple | Village |
| Coldwater | Burgess & Niple | Village |
| Bellefontaine | Floyd G. Browne | Bellefontaine Develop. Co. |
| **SOUTH CAROLINA** | | |
| Sumter | Joseph Palmer | Boyle Road & Bridge Co. |
| Waltboro | Ryan Engr. Co. | Wanamaker & Wells |
| **SOUTH DAKOTA** | | |
| Aberdeen | Alvord, Burdick & Howson | Fred E. Peterson |
| Rapid City | A. A. Chenoweth | Northwestern Engr. Co. |
| Winner | W. F. Cochrane | City |
| Sturgis | Chenoweth, Frazer & Forette | H. H. Hackett |
| **TEXAS** | | |
| Austin | City Engineer | City |
| Seagoville | Government Engineer | Dolph-Bateson Constr. Co. |
| **VIRGINIA** | | |
| Virginia Beach | Wiley & Wilson | Tidewater Constr. Co. |
| **WISCONSIN** | | |
| Beaver Dam | Jerry Donohue Engr. Co. | Permanent Constr. Co. |
| Portage | Greely & Hanson | PWA Labor |
| Platteville | Jerry Donohue Engr. Co. | Priester Constr. Co. |
| Elkhorn | W. J. Kirchoffer | PWA Labor |
| Lake Mills | W. J. Kirchoffer | PWA Labor |
| Fenimore | Jerry Donohue Engr. Co. | Pacholski & Doligalski |
| Sun Prairie | J. F. Parson | Roger E. Kilby Co. |
| Cedarburg | Jerry Donohue Engr. Co. | R. J. Wilson Co. |
| Verona | W. J. Kirchoffer | Parkinson Constr. Co. |
| Random Lake | Jerry Donohue Engr. Co. | Private |
| Plymouth | Jerry Donohue Engr. Co. | Kasper Constr. Co. |
| Sheboygan Falls | Jerry Donohue Engr. Co. | Paul Nagtegal & Sons |
| Baraboo | Mead, Ward & Hunt | Jefferson Constr. Co. |
| Reedsville | Jerry Donohue Engr. Co. | Chas. Gambsky Co. |
| Edgar | Consoer-Townsend & Quinlan | F. J. Vickers |
| Whitewater | Theo. Jensen | Ickes & Pankow |
| Oostburg | Jerry Donohue Engr. Co. | Hron Brothers |
| Sparta | Mead, Ward & Hunt | Stransberg & Spencer, Inc. |
| Burlington | Alvord-Burdick & Howson | Chas. D. Smith |
| Bonduel | Lytle & Smith | Kasper Constr. Co. |
| Fox Lake | Druar & Milinowski | Hron Brothers |
| Jackson | Jerry Donohue Engr. Co. | Hron Brothers |
| Eden | Architect Raeuber | Kasper Constr. Co. |
| Wautoma | General Engr. Co. | Ben B. Ganther Co. |
| Elmwood | Druar & Milinowski | Teberg & Berg |
| Lomira | Jerry Donohue Engr. Co. | Julius Lueck |
| Luck | Druar & Milinowski | E. Benner Lbr. Co. |
| **HAVANA, CUBA** | | |
| Vedado | Cristobal Diaz | Cristobal Diaz |

# AYER-McCAREL-REAGAN CLAY COMPANY, BRAZIL, INDIANA

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 63 to 65.



**Two-piece floor, Akron, O., plant, Metcalf & Eddy, engineers.**

of the walls, the pier for the distributor, the central drainage channels, the floor, the underdrainage system, the ventilation, the siphon chamber, the various piping and valve problems and the many other details that arise in design. The equipment manufacturer can help on some of these items, principally on the minor details of the distributor support, on the siphon chamber design, and on the underdrainage.

## Determining the Volume of the Filter

For many years, the volume of sewage flow was about the only factor considered in design as influencing the filter volume. The generally accepted rate of application of sewage was 300,000 gallons per acre-foot per day. (An acre-foot is an acre one foot deep, and contains 43,560 cubic feet.) Therefore the daily rate of application was about 7 gallons per cubic foot of stone. This rate was based on experience in operation, as was also the generally accepted filter depth of 6 to 10 feet—not less than 5½ feet, and usually 6 to 8 feet. A factor in the trend toward the deeper filters was the cost of piping in the distribution system (often a considerable factor when stationary spray nozzles were used), and also floor and wall costs.

Recent studies and experience have shown the need for a better method of determining the volume of stone needed. A consideration of the wide differences in sewage strength and characteristics will indicate that no set rule can be applied, and that adjustments must be made in volume to meet them. Hatch, Hall and others have suggested pounds of Biochemical Oxygen Demand as a basis for design. Since the real purpose of the filter is to supply oxygen to the sewage, thereby stabilizing it, this basis appears to be a sound one, even though it is not the whole story. There are many other factors which have a bearing. Among them are (a) the concentration or strength of the sewage and (b) its volume; also, probably very important is (c) the oxidizability of the waste, or its resistance to treatment.

The loading on a Biochemical Oxygen Demand basis is easy to compute. Assume a sewage with a B.O.D. of 300 parts per million, which by preliminary treatment is reduced to 150 p.p.m. for application to the filter. Since a gallon of water or sewage weighs 8.33 pounds, 150 p.p.m. amounts to 150 x 8.33, or 1,250 pounds of B.O.D. per million gallons. At a commonly used loading rate of 250 pounds of B.O.D. per acre-foot, 5 acre-feet will be required for a flow of 1 million gallons per day. The volume required for treating one m.g.d then would be 43,560 x 5, or 217,800 cubic feet of stone, about 8,000 cubic yards. If the stone depth is taken as 6 feet, there would be required 217,800 ÷ 6, or about 36,300 square feet, which is around 0.85 acre.

Most filters can operate effectively and efficiently for relatively short periods at a much higher rate than 250 pounds of B.O.D. per acre foot. Hall suggests a rate about three times as great as this, or 750 pounds of B.O.D. per acre foot for "short periods" but does not specify what a short period means. He further states that such heavy loadings over any prolonged period would be damaging. On the other hand, various experimenters have operated standard trickling filters at much higher rates—in some cases as high as 8 or 9 m.g.d.—with substantially the same results, according to unofficial reports.

*Summary on Organic Loading.*—Design must, of course, comply with State Board of Health requirements and regulations. Ohio and Indiana permit a loading of about 250 pounds of B.O.D. per acre-foot; Michigan, a loading, under certain conditions, up to 450 pounds of B.O.D. per acre-foot; Illinois, a loading on industrial wastes of 500 pounds.

Organic loadings are expressed also in pounds of B.O.D. per 1,000 cubic feet of filter stone (which is obtained by dividing the acre-foot loading by 43.56); in cubic yards (which is obtained by dividing the acre-foot loadings by 1,613); and also in area terms.

## Loadings in Terms of Flow Volume

In many installations, data on B.O.D. of the sewage are not available, particularly in the smaller installations. Also, where a complete new sewer system and treatment plant are being built at the same time, the plant must be designed before it is possible to know what the strength of the sewage will be. In any case, it is necessary to consider the volume of flow in connection with design.

A fairly standard rate of application for trickling filters is 300,000 gallons per acre-foot per day, or 1,800,000 gallons per acre of filter area 6 feet deep. Few, if any, state boards of health require a lower rate, except with abnormally strong and unusual sewages. A few permit higher rates—in some cases and under certain conditions as much as 600,000 gallons per acre-foot per day.

In the case of a very weak sewage, as a primary tank effluent having a B.O.D. of 60 p.p.m., the organic loading would be 60 x 8.33, or 500 pounds of B.O.D. per million gallons of sewage; and at the usual loading rate of 250 pounds per acre-foot, only 2 acre-feet would be required, for a flow of 1 mgad. In this particular case, the application on the basis of volume would be 500,000 gallons per acre-foot, and 2 acre-feet or 3,226 cubic yards of filter media would be required; by the method of designing by volume, at the rate of 300,000 gals. per acre-foot, there would be required 3.33 acre-feet, or 5,370 cubic yards. A somewhat higher rate than 300,000 gallons per acre-foot would probably be permitted in this case because of the weakness of the sewage.

*Influence of Strength on Results.*—It is generally found that a higher reduction *percentage* of B.O.D. is attained with strong sewage than with weak, though the actual B.O.D. of the filter effluent of the weaker sewage will ordinarily be lower. Forman and Shaw compared day and night flows in several New Jersey plants, and found the average percentage of B.O.D. reduction in night sewage to be about 80%, and of much stronger day sewage about 83%. For seven plants having excep-

tionally strong daytime raw sewage, the B.O.D. content averaging 495 p.p.m., the effluent contained an average of 85.5 p.p.m. B.O.D., representing a reduction of 82.8%. For the same seven plants, the night raw sewage B.O.D. was 281 p.p.m. and the effluent contained an average of 58.1 p.p.m. B.O.D., representing a reduction of 80%.

## The Dimensions Of the Filter

*Area.*—The total volume of filter required is determined by the methods already outlined. Using rotary distributors, the next problem is the determination of the number and size of the filter units. It is usually desirable, except in very small installations, to have two or more units, this permitting repairs and the performance of the necessary maintenance and operation functions. The determination of the most economical size involves the factor of depth also.

*Depth.*—Within limits, the deeper a filter is, the more stable its effluent, and the more dissolved oxygen it contains. Filters having a depth less than 6 feet should be constructed only under special conditions which fully justify the selection of a shallow unit, as when a deeper filter would require pumping, very costly or unsafe footings. The purification per unit volume of filter generally decreases when the depth exceeds 8 or 10 feet, and the additional oxidation obtained by depths greater than this are slight and seldom worth the cost.

A certain amount of head is required for effecting the distribution of the sewage onto the filter (this will be discussed later); and the effluent leaves the filter at the level of the drain in the filter floor. There is therefore a drop in level from the point where the sewage enters the distributor to the point where it leaves the filter equal to the sum of the distribution head (usually 3 or 4 feet) and the depth from the surface of the filter to the liquid in the drainage channel at the outlet—about 8″ to 12″ plus the depth of the filter medium.

In fitting the filter to the general flow plan of the plant and to the topography, it may be found that it will come wholly in excavation, or partly or wholly above the surface of the ground. In some cases topography may permit adjustment of this, but unless it is desired to make the walls open for ventilation it makes little difference, except as a matter of construction cost, to what extent the filter extends above the surface. It is general practice, if part of the filter is below ground, to place an embankment around it, with the fill level extending to within a foot or two of the coping level, partly as matter of appearance.

*Economic Factors.*—The following principal elements enter into the cost of a filter: (1) excavation; (2) the walls; (3) the floor system and underdrainage; (4) the filter media; and (5) the distributor cost.

The cost of the filter media is not affected by depth or number of units built. Excavation will not generally be affected to any considerable extent unless an appreciable part of the filter stands above the ground surface. The cost of the floor system is influenced by the depth, the deeper the filter the less being the proportional cost of the floor system. The more units there are, the more the walls and the distributor equipment will cost. There are, of course, other items entering into this, but the five listed are the principal ones.

Assume a flow of 600,000 gallons per day, a rate of application of 300,000 gallons per acre-foot per day, and a depth of 6 feet. The area required will be 0.33 acre, or 14,520 square feet. This can be handled with one unit having a diameter of 136 feet, in which case the wall length for the circular filter would be 427 feet. Two filters, each 96 feet



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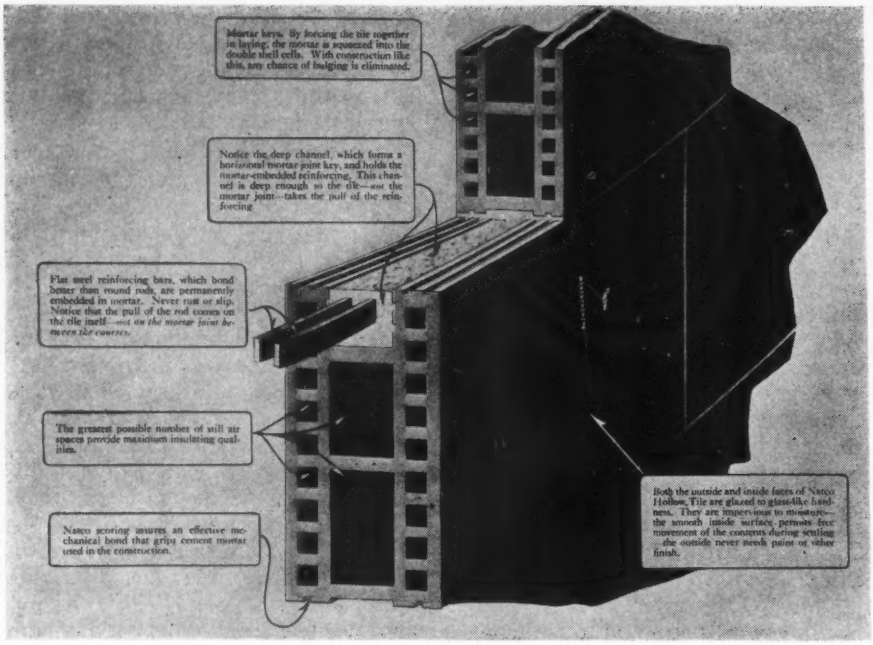



**Detail showing reinforced wall, using segment tile blocks.**

in diameter, would provide the same area, with a wall length of 603 feet. Three filters of the same total area would require a diameter of 79 feet and a wall length of 745 feet.

Assuming a wall cost of $7 per lineal foot and a distributor cost of $20 per foot of diameter, the costs for the above units are: For a single 136-foot filter, $2,720 for the distributor and $2,989 for the walls. For the two 96-foot filters, $3,840 for the distributors and $4,221 for the walls. For the three units, $4,740 for the distributors and $5,215 for the walls. However, these costs are only a part of the total cost for the filter and should not blind the engineer to the desirability of providing two or more units. In practice, distributors are not generally made in the sizes listed, and would probably be 135 or 140-foot for the single single filter; 95 or 100-ft. for the two units and 80-ft. for the three.

If a depth of 8 feet were selected, the area required would be 0.25 acre, or about 11,000 square feet. A single unit 118 feet in diameter (120 feet), two units each 83 feet (probably 85-ft.), or three units 68 feet (probably 70-ft.) could be used. The saving accomplished by the deeper filters can easily be computed, allowance being made for the cost due to the increase in wall height and consequent greater wall section.

## Details of Design

The filter media might be placed in position without containing walls, the sides being allowed to take their natural slope; in fact, some early filters were so made. But sewage, in passing through a filter, moves vertically with practically no coning, and the slopes of the media therefore perform no function except to take the place of a retaining wall; while this construction increases the area of ground and of floor required by that of a strip surrounding the filter and having a width approximately equal to the depth of the filter.

Where the filter is in excavation, this has in some cases been made with sloping sides and filled with filter media. Here the outer strip, beyond vertical planes rising from the toes of the slopes, has effective depths less than that desired; and while they would produce some beneficial effect, if dosed, this would be much less per unit volume than in the rest of the filter. The slopes should be paved, as otherwise the sewage would wash dirt from them into the filtering material and even into the drains. There is also danger that sewage will be distributed over this outer strip at as high a rate as over the rest of the filter, thus lowering the efficiency of the filter as a whole. The cost of excavating, of the stone over the slopes, and of the slope paving may nearly equal that of a vertical retaining wall; the saving, if any, being more than offset by the lack of any advantages.

It therefore is now standard practice to surround a filter with vertical retaining walls, whether partly or wholly either above or below ground. Another reason for this is that, where it is desired to control filter flies by flooding the filter, the medium must be entirely enclosed in a water-tight structure.

*Shape.*—Most filter units now being built are circular in shape, because with rotary distributors this is the most efficient shape. With fixed nozzles, only a little more than 70% of the bed area was properly dosed. With the rotary distributor, practically 100% of the area is evenly dosed.

A few recent installations, even though using rotary distributors, have been built as octagons. This shape may have some advantages in appearance, but wastes some space, as the distributors cover only the inscribed circle.

One type of distributor is of the reciprocating type and operates back and forth on tracks placed on the side walls of rectangular beds. This gives the same even distribution accomplished by the rotary distributors. Also, when fixed nozzles are used, the beds are normally rectangular in shape. The various distributing equipment, including spray nozzles, will be described under *Equipment.*

## Walls

*Tight vs. Open Walls.*—Tight walls permit the filter to be flooded, if desired, for the control of filter flies, but some engineers feel this construction may interfere with the desired or necessary ventilation. Open walls, whether of stone, tile or concrete with special openings, may aid in ventilation, but do not permit flooding the filter. In general, it appears that in cold areas, the tight walls are more desirable, as aiding in keeping the body of the filter warm and so promoting biological action, whereas in warm climates open walls may offer some advantage in providing additional ventilation.

The containing walls of the filter, whether tight or open, must be stable enough to resist overturning pressure from the filter stone without aid from the earth backing, or pressure from the earth backing if the stone is not in place. Also, in the case of tight walls, stability must be great enough to prevent overturning when the filter is flooded, neglecting the pressure of the earth backing.

Walls may be made of any one of a variety of materials—concrete, tile, steel and wood have been used—choice of which may be affected by the shape. A wall of a circular filter may be designed to resist stresses as a cylinder while a straight wall is designed as a retaining wall.

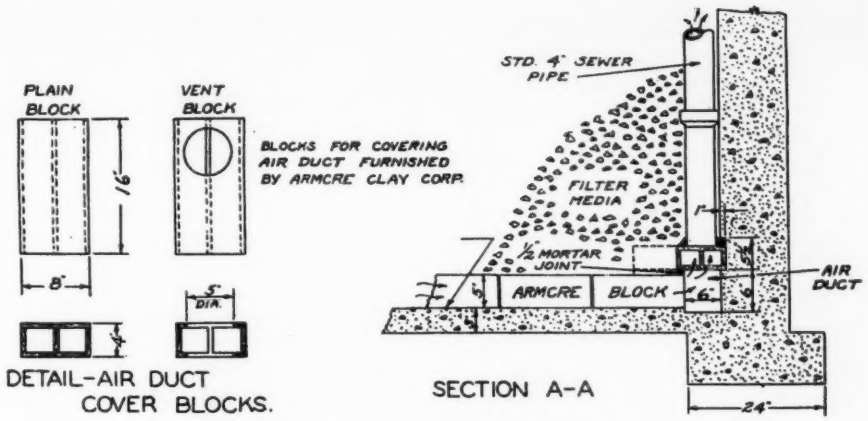
*Materials.*—Concrete is most generally used, though some stone walls laid either dry or in mortar, have been built. Recently, vitrified tile blocks have been used for constructing the walls of some filters.

For concrete, a good mix should be employed—not less than 1:2:4, with carefully controlled water-cement ratio. From 6 to 7 gallons of water per bag of cement, including the water present

in the aggregates, produces a mix as wet as should be used. Too much water causes honeycombing and other defects. Forms for concrete walls should be tight, smooth and clean. Plywood, tongue and groove, or metal forms should be used.

If stone is cheap locally and skilled masons are available, a stone wall may be cheap and satisfactory, but masons are usually scarce and high-priced. If an open wall is desired for ventilation, the stone is laid dry. Because sewage percolates through the filter almost directly downward, with but little coning, such walls rarely show any leakage or seepage. A good foundation is necessary, and the wall must be designed as a gravity section, thick enough throughout to provide stability.

Structural hollow tile, if used, should be vitrified. They have the advantage of furnishing heat insulation, which is desirable as conserving heat to promote biological action. Because of their construction, they are lighter in weight than concrete and therefore straight walls built of them must be thicker or have a wider footing to secure the necessary stability. The insulating benefit could be obtained by using them as a lining to a concrete wall, either inside or outside, or both. Use of glazed tile on the outside may greatly improve the appearance of a wall.




**Details of wall, underdrains and vents.**

If an open wall is desired, tile can be used with the openings running through the wall. In this construction the horizontal pressure of the filter stone is exerted against the ends of the tile blocks only, while the stone that slopes into the ends of the tiles adds to the stability by its weight. These walls therefore do not need to be so thick as do tight walls. Several such filters have been built in the southern states.

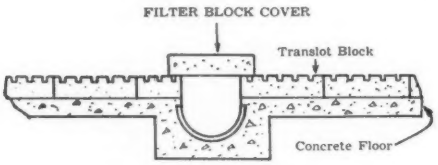
If the filter is circular, a tight tile wall may be comparatively thin and the stresses be taken by circular reinforcing. Segment or radial hollow tile are made for this purpose, 6″ or 8″ thick, curved to any desired radius up to 50 or 60 ft. and containing recesses for reinforcing rods and bonding at both horizontal and vertical joints. The tile are glazed on both inner and outer surfaces and very pleasing effects are obtainable. Costs of tile and of concrete walls generally will be about the same, although this depends on local costs, freight rates, etc.

*Thickness and Section.*—The thickness of the containing wall of the filter, if of concrete, is usually 8 to 12 inches, depending somewhat on the height; surcharge, if any; and other factors.

With a circular filter designed by the cylinder formula, the stress is taken by the circumferential reinforcing and vertical reinforcing is secondary. A straight wall is designed as a retaining wall and should be stable against any normal force—stone pressure within, with no earth backing; hydrostatic pressure, if the wall is tight, with no earth backing; and earth pressure from without with no stone in the filter. Generally, it is better to construct a reinforced concrete wall than a concrete wall with a gravity section.

Concrete walls for rectangular filters with no more than 6 feet depth of stone, if 12 inches thick, with a footing 3 feet wide, will ordinarily be stable against stone pressure, but not against hydrostatic pressure; and may not be stable against earth pressure without stone in the filter. Therefore, this section should be checked against local conditions where the filter is in cut. Adequate reinforcement must be provided.

Stone walls should ordinarily be of a safe gravity section, with the base about two-thirds as wide as the wall is high.




Special cover for central drain

Walls of tile block for circular filters should be reinforced and firmly anchored to or slightly inset into the base. For straight walls, the weight of the blocks, or their resistance if used as crib walls with openings through the walls, must be considered in design.

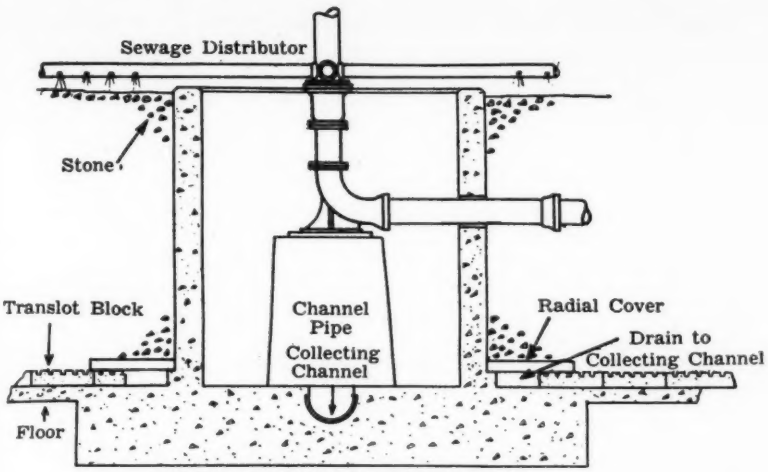
*Design Factors for Stability.*—On straight walls, as for rectangular or octagonal filters, stability is computed as for retaining walls. A value of 45° for the angle of repose for broken stone can usually be adopted, through a safer design value would be the same as earth; for earth backing, 1½ horizontal to 1 vertical is a standard design ($Z=33°41'$). The weight of crushed stone can be determined locally; usually it will not exceed 100 pounds per cubic foot. It is safest to assume 115 to 125 pounds for the possible weight of the backfill when wet. For a watertight wall, calculate for hydrostatic pressure with the filter full to the top of the wall. The pressure on this basis will considerably exceed that for either crushed stone or earth. With circular walls, it is not necessary to design for stability against overturning, if circumferential reinforcing is carried entirely around the unit, and lapped.

*Freeboard.*—Low freeboards permit wind to interfere with distribution of sewage to the bed. High freeboards protect against wind, but permit or encourage drifting of snow or deposits of leaves or weeds by winds. Most of the rotary distributors are set fairly close to the surface of the stone—normally about 12 inches, but sometimes as low as 6 inches. While local experiences and conditions, such as temperatures, will govern, a freeboard of not more than 6 to 9 inches is ordinarily sufficient for distributors. A 12-inch freeboard is common for spray nozzles.

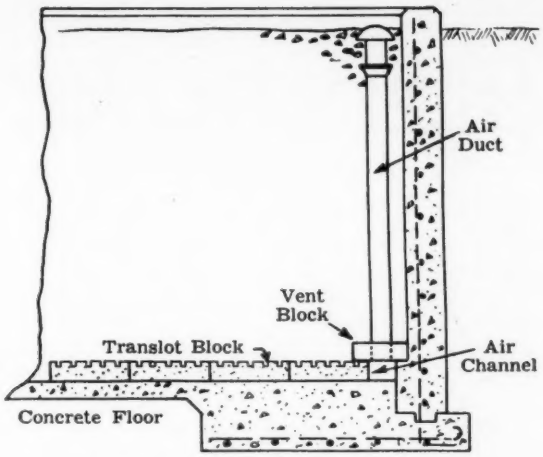
## The Filter Floor

The floor of the trickling filter should invariably be made of concrete or similar firm material, which will retain indefinitely its cohesion and its uniformity of surface and slope. It must provide a firm support for the underdrains and prevent the filter media from becoming mixed with the earth beneath. An earth or gravel floor, no matter how well compacted, is not satisfactory

Concrete floors are usually made 6 inches thick and lightly reinforced, though some 4-inch floors have been used. The loading on a filter floor is not great—about 6 feet of stone weighing about 100 pounds per cubic foot—and excessive strength is not required.




SECTION THROUGH CENTER WELL OF CIRCULAR FILTER PLANT




OUTSIDE WALL SECTION OF CIRCULAR FILTER PLANT

Uniformity of grade and smoothness of surface are more important, as these factors permit the highly important drainage system to function efficiently and without trouble.

Reinforcement for floors is normally bar mat or fabric, about 5 pounds per square foot or ½-inch bars 12 inches on centers both ways. The reinforcement may be placed in the middle of the concrete section.

It is better to pour the whole floor in one run, but if the subgrade is firm there is no particular objection to joints in the floor. Reinforcing should be carried through the joints, or dowels provided, and joints should run in the same direction as the slope of the floor. Where the subgrade is poor, a footing should be placed under the joints to provide support.

Especial attention should be given to the preparation of the earth for placement of the floor. The subgrade should be well compacted and firm and finished to the exact grade necessary.

*Slope.*—It is customary to slope the bottom of the filter to a central drainage channel, in the case of circular filters; but with large rectangular filters, two or more channels may be provided. In some English installations, the slope is from the center of the filter to an outside peripheral channel. A floor slope of about 0.3 feet per 100 feet is sufficient, though on small filters the slope may be greater—generally not less than 2 inches fall being provided for the semi-diameter.

# Letters to the Editor

Editor, Public Works.—"I was interested in Mr. Lauster's simplified calculations for digestion capacities in Public Works for January, 1940. I doubt that multiplying the solids production, in either dry or wet form, by the number of days of storage gives the actual digestion capacity. Volume of seed and supernatant must be taken into account as well as compacting of solids, solids destruction by liquefaction and gasification and solids present in the overflow; even if a definite digestion time is assumed.

"Is 0.55 lbs. of garbage per capita daily (about 31% of sewage solids as given by Mr. Lauster) a reliable figure? I would like to know, because several sources state that the quantity is around 0.15 lbs./cap./day. Knowing your interest in the subject I thought you might know.

"By the way, Mr. Lauster's increase of 32% in digestion capacity (using 31% of the sludge solids) checks nicely with my assumption that addition of 100% garbage would double the capacity."

W. RUDOLFS
Chief, Dept. Water & Sewage Research

[ED. NOTE.—*We believe Mr. Lauster's figures for garbage per person per day are essentially correct. Further information is now being gathered by Public Works through a survey of all cities of more than* 5,000 *population, and will be published in an early issue.*]

* * *

Editor, Public Works.—"I have read the article in Nov. issue on soil heating cable, but have been unable to find out where to buy any. Can you give me the name of a manufacturer.

"I want it for quite another purpose. I have a consumer who has trouble with water from the roof freezing in his down spout causing it to clog up and overflow. He wanted me to thaw it with the electric thawing machine which I explained to him would not be practical. This happens only once or twice a winter but ruins his wall paper. I had an idea to allow a cable to dangle in center of down spout with suitable electric switch in his house, so he can turn it on when it is so cold that water running down the spout freezes, although the sun melts the snow on the roof."—L.M.W.

* * *

THE road superintendent of a town in Colorado writes us that the main street of the town, which runs east and west, was paved with cement concrete in 1917. After 23 years of use, this pavement, along the south side of a stretch four blocks long where snow and ice accumulate, has reached a condition where maintenance is quite expensive. He asks for advice on a bituminous surface. Answer by Bernard E. Gray, Chief Engineer, Asphalt Institute:

"The resurfacing of old portland cement concrete is not a difficult thing to do, but it does require an understanding of the basic principles involved. The usual error is to apply a patching mixture to the surface which is so tacky that, while it is an excellent material itself, no bond is obtained between it and the old pavement. Thus if any further movement takes place in the concrete, the patch will soon loosen and disappear. This same lack of bond is usually the cause of failure of thin treatments, even of liquid bituminous material. If of the quick curing type, they do not make a bond and once the surface is broken, disintegration follows rapidly. It is therefore necessary to do one of two things. (1) Either to apply a light surface treatment of a material which is so penetrating in character that it becomes practically a paint coat over the surface, or (2) to place a new surface which is of such depth as to have inherent structural strength within itself and where no bond is therefore required with the underlying base. However, in the second instance it is desirable to prime the old concrete with a highly penetrating bituminous material so as to seal the cracks and prevent the rise of capillary moisture from under the concrete pavement.

"In the first instance, the best procedure is to apply approximately ½ gallon of a medium-curing cut-back or a slowbreaking asphalt emulsion which will thoroughly penetrate all of the cracks and crevices and with still enough material left on the surface to hold a cover coat. This cover coat should be sand; under no circumstances should it be a coarse aggregate material. Following out the principle laid down of a paint coat, only a fine aggregate should be employed, sufficient to mop up the excess asphaltic material and to provide a certain resistance to abrasion. The sand does not have to have any particular grading but it should all pass ¼" screen. Such treatment will often give a surprisingly long life provided the old concrete road is not too much broken up and subject to further breaking under traffic. The mat is soft and will yield without breaking and yet maintain a waterproof surface.

"Now as to the second situation, resurfacing with a definite pavement type. This can be done, as you have suggested with a road-mix type which may be either the macadam aggregate or the dense graded mix. It can be done with any type of plant-mix. It is often done with straight asphalt penetration macadam. In any event, the minimum thickness should be 1½" and preferably 2"."

* * *

The manager of a water company in Pennsylvania asks if the readers of PUBLIC WORKS can give him advice on prevention of services from freezing. His problem is as follows: "I would like to know if any of your readers have had any experience in preventing service lines freezing under the street by using a special material for imbedding the pipes.

"The W.P.A. have changed the grades so that many of our service lines freeze unless allowed to run. The mains have enough circulation to prevent freezing. I am considering the idea of lowering the service lines out to the main, and come straight up to the corporation cock in the main. This leaves only a small vulnerable point. I thought if I covered the corporation cock and the vertical piece of pipe with asbestos cement, and then covering the asbestos cement with a mortar of sand and cement to protect the asbestos, I might save the expense of lowering and cutting mains. Can you or your readers give me any ideas or suggestions?"

**Abstracts and Condensations of Some of the Papers Presented at the American Road Builders' Meeting**

# Design Features of the Pennsylvania Turnpike

**As outlined by SAMUEL W. MARSHALL, Chief Engineer**

OF the many articles which have been written about the 160-mile Pennsylvania Turnpike, most of them play up the spectacular features to such an extent as to entirely overshadow the many interesting engineering ones, if indeed these are not overlooked altogether. A commendable exception is a paper before the American Road Builders Assn. by Samuel W. Marshall, Chief Engineer of the Pennsylvania Turnpike Comn., dealing with the design and construction of the turnpike. From this paper we have abstracted descriptions of the leading features which are of general interest to highway engineers.

Safety for vehicle operation has been the keynote in designing. In endeavoring to secure this, the fundamental objectives are:

(1) The separation of the streams of traffic flowing in opposite directions to reduce the possibility of head-on collisions and side-swipe accidents.

(2) The elimination of all highway and railway grade crossings, so that there will be no cross traffic.

(3) The provision of wide smooth stable shoulders level with the pavement in order that vehicles may park completely off the paved area and to provide "elbow room" in cases of traffic emergency or mechanical failure of the vehicle.

(4) The provision of two lanes of pavement in each direction in order to reduce the menace due to slow moving vehicles, to eliminate the necessity of encroaching on the lanes of opposite direction traffic when passing and so that there may be no delay in passing.

(5) The provision of traffic lanes of sufficient width adequately to care for the safety, comfort and convenience of all classes of traffic.

(6) The elimination of all frontage, "wildcat" commercial development and local farms entry along the right of way and the complete control of that right of way.

(7) The exclusion of pedestrians.

(8) The provision of moderate rates of grades in order to increase safety during icy weather and to increase the speed of large heavily loaded trucking units so that rear-end collisions between fast and slow vehicles are minimized.

(9) The provision of uniform and consistent operating conditions.

(10) The provision of specially designed access facilities at reasonably long intervals with acceleration and deceleration lanes in order that vehicles may enter and leave the main highway with reasonable safety and a minimum of traffic disturbance.

This turnpike is the first long-distance express highway in America designed with all these safety factors.

Maximum grades were limited to 3%, made possible only by tunneling the higher ridges of the Alleghenies at seven points. The graded width of the roadway is 78'. The maximum curvature is 6° (955 ft. radius), and these curves are confined to one section 6 miles long; outside of this section there are only 8 curves sharper than 4°. Tangents that are 6,000 ft. or more long are connected by curves reduced to the absolute practicable minimum; those more than three miles long by 30' curves (11,000 ft. radius). Curves of 30 minutes or more are superelevated; and those of 2° 15' or more are spiralled.

For culverts, extra-strength reinforced concrete pipe is used in fills less than 25 ft. deep; in deeper fills, 8-gauge corrugated metal pipe, fully bituminous coated, is used "because of its recognized properties of building up additional resistance against failure after a slight deformation." In setting these pipes, struts were used to obtain additional vertical diameter before the settling of the embankment.

For bridges, the design loading adopted was that designated as S-20-12; a tractor-trailer with 8,000 lb. load on the front axle, 32,000 on the intermediate axle, and 24,000 on the rear axle, is assumed as placed at the critical point on the structure, the rest of the structure being occupied by 20-ton trucks spaced 44 ft. on centers.

There are 140 grade separations, about 80 carrying the turnpike over the intersecting road. Rigid frame structures over the turnpike have a span of 78 ft. clear normal to the abutments, and skews range up to 30 ft.

In a number of cases it would have been economical to design twin spans, placing piers in the medial area of the turnpike, but considering the importance of safety to traffic, this was avoided in many cases. In 23 cases, however, after due consideration of the comparative costs, the volume of traffic and safety conditions, this additional expenditure could not be justified. Single spans were impracticable, also, where the skew was excessive, reaching as high as 70°.

For concrete structures, both crushed stone and washed gravel were permitted. For reinforced concrete pavement, crushed stone is required (except that washed crushed gravel is permitted in one county). Concrete pavements are 10"-8"-10" reinforced.

Because of the great speed at which this work is being done, the size and amount of the equipment used is unprecedented. On November 1, 1939, there were employed on this work 160 power shovels, many of them 3 or 4 cu. yd.; 182 carryalls or scrapers of from 6 cu. yd. to 35 cu. yd. capacity; also trucks, wagons, power graders, bulldozers, rollers and auxiliary equipment; the whole having an estimated value of $12,000,000. "Undoubtedly the turnpike in the past twelve months has been the proving ground for more new larger equipment as well as modified types of design, than any other single highway construction project, and unquestionably the experience gained on this work will result in many worthwhile improvements and innovations on highway construction."

# Highway Design and Construction as a Factor in Accidents


**By SIDNEY J. WILLIAMS**
**Director, Public Safety Division, National Safety Council**
**Chicago, Illinois**


A HIGHWAY accident, as a rule, is not the result of one cause alone. Most often, the factors in a highway crash include something less than perfection in the design, maintenance or equipment of the highway system, and something less than perfection in the mechanical condition of the vehicle, along with some lack of skill or attention on the driver's part—and often on the pedestrian's part too.

It is axiomatic in all safety effort that whenever we can stop a certain type of accident by either engineering improvement, enforcement, or education, the first is much the best, for the simple reason that the engineering remedy is permanent while the others are only temporary. We learned years ago in industry that it is easier and cheaper in the long run to put guards on dangerous machines rather than trying to educate and discipline successive generations of workmen to keep away from them.

We can come quite close to 100% safety on a modern type superhighway or limited way, meaning a divided highway with all important crossings separated, generous lane widths, easy curves and grades, long sight distances, shoulders, guard rails, and all the rest, and preferably with no access from private premises. No other type can be regarded as permanently acceptable for arteries between important centers of population, and modifications of this basic design must and will be used also to bring these highways into the centers of large cities.

It would be a great mistake, however, to think of super-highways as the only engineering answer to this problem of traffic accidents and congestion. How about the millions of miles of highway that will never reach this stage? How about the large additional mileage of new secondary roads that is demanded and needed? How about present traffic on heavy trunk lines before rebuilding or replacement becomes an actuality? How about city streets with their added problem of frequent intersections, buildings to obstruct the view, and high property values: Are we to say that highway engineering skill has no answer?

The answer of course is an emphatic NO. Engineers can meet this demand in the following ways:

1. By building safety factors into all new two-lane trunks and all secondary and feeder roads. The American Association of State Highway Officials and the U. S. Public Roads Administration are doing a fine job in defining specifications, including safety factors, for various classifications of highways.

2. By removing existing hazards on present highways of all classes—widening of narrow slabs; shoulders and guard rails; easing curves and hills; lengthening sight distances; improving slippery surfaces; lighting where needed; protecting railroad grade crossings; center lines and other markings; sidewalks where pedestrian travel is large; standard signs and traffic signals where needed; removing poles, trees and other fixed objects from the roadway or shoulder; studying traffic flow and routing traffic to minimize the congestion and delay that lead directly or indirectly to so many accidents.

3. By contributing engineering analysis to the consideration of legislative, enforcement and educational problems. A conspicuous example is speed zoning.

There is no simple answer to the complex problem of excessive speed, but the highway or traffic engineer is more and more contributing one partial solution by fixing reasonable limits on certain stretches of highway.

4. By using, in the application of all these remedies, the "accident approach," which means carefully collecting, analyzing and interpreting the records of fatal, personal injury and property damage accidents which have actually taken place at some one point or on some one stretch of highway. Few if any of us are able today to drive over a highway and determine from our wisdom just how hazardous it is or will be. The only sure test is experience. Exactly what accidents have occurred on this piece of highway in the past year, or the past five years? There is a good deal of luck in individual accidents, but if a given highway has actually proved accident-free, the chance is very small that it will later develop a bad record.

Hazards that are obvious to the engineer are often obvious to all drivers; caution is exercised and there may be delays but no serious crashes. It is the unexpected hazard that is really dangerous.. Only the most meticulous study of the accident records can enable us to feel certain that we are recommending the spending of money for highway improvements in the way that will save the maximum number of lives, limbs and dollars.

## Governmental Relationships—A Committee Report

THIS report brings out points tending to fuller cooperation and better relationships between all governmental agencies, in design, construction, maintenance and financing of highways. Alan N. Buck is chairman of the committee. The entire subject has been divided into six subdivisions, as follows: Federal, State and County Cooperation in Highway Work, A. F. Ranney, chairman; Improvement of Relationships between County and State Agencies, R. B. Traver, chairman; Plans for Joint Participation by States and Counties in Local Road Selection and Progressive Improvement, Guy M. Balfour, chairman; Advantages of a State Agency, E. Friedman, chairman; A Plan for Utilizing Existing County and Township Agencies, P. J. Keller, chairman; A Study for Joining State and County Administrations to Effect Closer Working Efficiency and Assistance to Weaker County Units, L. P. M. Gaylord, chairman.

*Federal, State and County Cooperation.* Cooperation of these three governmental units, to be effective, should so distribute among them the various functions and powers as to reduce duplication to a minimum. The Federal Bureau of Roads would be in charge of administration, and contain representatives of counties and states, so that Federal planning can be coordinated with State and County programs. Some division of the P. R. A. should be devoted to making specific contact with County officials.

The State should supervise all major highway construction, including planning and designing, through its highway department.

The Counties should have charge of the maintenance of all roads, including State; also be entrusted with its own construction problems, and be represented in the supervision of State and Federal construction within its boundary. It would be desirable to avoid duplication caused by Township, Village and City departments, by having one engineering, construction and

maintenance department to handle all engineering problems in the county. A. F. Ranney, Chairman.

*Improvement of Relationship Between County and State Agencies.* State officials are apt to look down on County engineers because in the past they were generally appointed solely for political reasons—often knew nothing whatever of engineering. Selection of County engineers should be through competitive examination, requiring selection of technical trained engineers with some years of highway experience. In counties of New York State that recognize, in salary paid and qualifications required, the responsibilities of the County engineer, there is the best of feeling existing between the departments. Such feeling will become general only when the County engineers are organized to change the methods of appointment, establish uniform requirements as to qualifications and better salaries. R. B. Traver, Chairman.

*Joint Participation by the States and Counties in Local Road Selection and Improvement.* Methods of selecting the roads to come under the Secondary Federal Aid Program have varied widely in the different States. In some States, the directors of highways have arbitrarily made this selection without consulting County engineers or other local officials. Legislative action in some States has transferred these roads from the County to State administration. Other States show a close cooperation between State and County in the selecting of these roads. Varying degrees of State and County participation and cooperation are indicated in others.

The classes of roads included in the Federal Aid system has also shown variation among the States. Reports indicate that some States are taking advantage of these funds in improving potential primary highways—roads which should properly be classed as arterial highways. Tendencies in some are to include, first, the present permanently constructed roads and little of the mileage in vital need of improvement. The regulations can no doubt control this problem more closely in the future. Clarification of what shall constitute Federal Aid Secondary Roads will be helpful.

The jurisdiction regulating the County-State relationship in the selecting of local roads for this program should be with the Federal authorities. Otherwise there is little hope of uniformity to any degree. After the allocation is made to each State and the mileage apportioned to each State, this mileage should be broken down to the different Counties on a basis which should include such factors as present road mileage; population; valuation; automobile registrations, etc.

Notice of this allocation should be made to each County by the director of highways. Regulations should provide that the County road engineer make a report to the board of county commissioners or supervisors covering his recommendations of the road mileage to be included under Secondary Federal Aid. The commissioners, or supervisors, should examine this report and concur in or amend the report, after which it should be filed with the State director of highways. This report should contain details covering the basis for selection of the roads specified in the report. The director of highways should check these reports and either approve them or recommend changes back to the county boards. In event no agreement is met between the County and State, both reports should be filed with the Public Roads Administration where final decision should be made. With the comprehensive survey and traffic count, and the mapping of every County in the Nation by our Federal Public Roads Administration, information

and data on local roads are brought very close to the Federal administration. G. M. Balfour, Chairman.

*Advantages of a State Agency.* A State Agency would be in a better position to determine the necessity for Federal Aid as regards local roads; it would be more flexible in its requirements as to the types of road construction and would, undoubtedly, be more elastic in permitting the use of local materials for construction methods purely adapted to local conditions. It would probably not be bound by standards now set up by the Bureau of Public Roads, some of which are not required in local road construction. This would not mean a let down of the standards of work required, but it would permit the closer adaption to local requirements. Administrative details would be handled much quicker and undoubtedly would eliminate much of the so called "red tape." There is no reason for State highway departments administering Federal Aid on local County roads unless they are part of the State road system.

Disadvantages of a State Agency include the possibility of local pressure being brought to bear against a State agency for special consideration. This, however, can be avoided by Federal Aid requirements as to local participation and designation of types of roads on which Federal Aid money is spent. The possibility of inferior engineering design and supervision can be avoided by requirements that all Federal Aid work on local roads be designed and administered by properly qualified professional engineers. E. Friedman, Chairman.

*Joining State and County Administrations for Efficiency.* There are many different set-ups as between state and county highway organizations, in fact probably 48 different plans. In some states the counties are set up in small units, approaching the size of townships in other states. A township in one state might be better equipped as far as technical administration, planning and equipment than a county organization in another state.

The problem of joining state and county administrations in a closer cooperation can be developed if there is a willingness on the part of the individuals and the groups of individuals involved. It should not be necessary to point out the need for trained men as administrators of highway organizations, and it would appear that in the states where the county is a definite part of the municipal set-up that practically all county units are now headed by professional engineers. In cases where this is not true, the state department should approach the matter from a reasonable standpoint and try to correct the weakness by helpful suggestions rather than dictatorial criticism, thereby antagonizing the people who are paying the bills—the tax payers. L. P. M. Gaylord, Chairman.

## Counties Not Liable for State Highway Construction

The Texas courts hold that the State Highway Commission and not the counties is liable for damages to private property in the construction and maintenance of the state highways and that all improvements of state highways, under the statutes, shall be made under the exclusive and direct control of the State Highway Department. The counties are merely authorized by the statutes to lend aid in securing right of way and contributing funds for such construction. (Iverson vs. Dallas County, Texas Court of Civil Appeals, 110 S.W. (2d.) 255.)

## Methods for Estimating the Corrosivity of Soils

The Magnolia Pipe Line Co. measured the depths of the deepest three pits on each joint of a 25-mile pipe line, and also estimated the condition of each joint. The resistivity of the soil was measured with a Shepard resistivity meter at 200-foot intervals. A soil survey of this line was made and several samples of each type of soil were obtained.

The pH values, total acidity, and electrical resistivity at saturation and at moisture equivalent of the soil samples were measured. The corrosivity of the soil samples has been determined by methods which include those devised by Corfield, Denison, Legg, and Putnam, and the results of these tests, as well as the corrosivity of the soil as indicated by its field resistivity, resistivity at moisture equivalent, and by its acidity, have been correlated with the depth of the deepest pit on the joints of pipe nearest the points where the samples of soil were obtained. The correlations are presented in the form of charts. They show that the result of a single test by any of the methods tried cannot be depended on to predict correctly the depth of the pit which may occur in the soil represented by the sample. However, if the data for all the samples from a soil series are averaged, the results of tests by any one of several methods will give a satisfactory indication of the average corrosivity of the soil series.

It has also been shown that there is a reasonably close relation betwen the depth of the deepest pit on a joint of pipe, the estimated condition of the pipe, and number of leaks.—*Journal of Franklin Institute.*

## Tar in Surfacing and Soil Stabilization

*(Continued from page 14)*

all of the larger sized aggregate comes through this mixing process almost entirely uncoated. But since these particles are surrounded by a matrix of fines which are coated with tar, the entire mass is rendered water resistant. A check which proves this is to take from the road some of the mix and place it in an ordinary drinking glass and pour water on it. If this water does not become discolored, the material has been thoroughly mixed.

Temperature does not seem to have a very pronounced effect on mixing operations where there is moisture present.

The finished mix is a loose, mealy material; a handfull of it will run through the fingers like black sand, and does not stain the fingers. There is no difficulty in spreading or shaping this processed material. There is no critical point when it takes a "set." At intersections and points where mixing in place is not practical, untreated material is trenched out and moved to any convenient location which can be used as a mixing board. After being mixed by the grader, it is hauled back and raked into place.

The fines are recognized as the actual binding agent in these traffic-bound roads. Tar is used to prevent these fines from becoming detrimentally wet, without destroying their binding properties for water proofing rather than for binding; therefore, one cannot look to established practices for guidance in the matter of bitumen percentage.

The tar is applied in quantities ranging from less than 2% up to 4% of dry weight, depending upon the characteristics of the aggregates. On most of this work a tar content of around 2% is found satisfactory. For

mixing and tack coat, tar RT-6 is the grade most widely used. This grade mixes readily under the conditions and with the materials encountered in Indiana.

### Finish and Compaction

Whether the loose material is laid out for finish in successive layers or in one operation, it is kept shaped up by continuous blading. The tools used in the blading and shaping operation accomplish a large part of the compaction necessary. Final compaction is accomplished with rubber-tired rollers, loaded trucks, power graders and flat-wheeled rollers. A flat-wheel roller is necessary for finished rolling—preferably a 10-ton roller.

This rolled surface will not stand abrasive effect of traffic, but must receive a tack coat immediately upon completion of rolling. The tack coat consists of approximately .25 gallon per square yard of the same grade of tar used in the mix. The road should be opened to traffic until the wearing course is applied.

For wearing course, Indiana's practice is to use 0.3 to 0.4 gallon of RT 9 and suitable covering material.

### New Construction

To this point only processing of old material has been discussed. However, new material has been processed with equal success. One road .8 mile in length was built in 1938. New material was applied having a large clay content with no aggregate over ¾". Four inches of this was spread over the road bed. In mixing, 2 inches of the subgrade, which was ginger sand, was drawn in. In the spring of 1939, this road was used as U. S. 20 detour, an average daily traffic of 3900 cars and 850 trucks traveling over it. After 5 months of such traffic, a careful inspection disclosed no signs of structure failures.

The unusually small amount of tar used and the use of such material as is present make this type of structure very economical. A fair estimate runs about 30c per sq. yd. In most cases the only material added is the cover coat. This eliminates the cost of placing new material.

*Acknowledgment.*—These articles are abstracts of papers presented by Messrs. Witt and Hanson at the 1940 meeting of the American Road Builders' Association.

## The Role of the Filler in Bituminous Road Construction

Bituminous road surfacings can be rendered fully adequate to the demands of modern traffic in respect of smoothness, stability, and non-skid properties by the use of bituminised filler. The filler performs several functions, the most important being the stabilisation of the bituminous binder. According to the type and quantity of filler used it is possible to raise the softening point and drop point of the binder and hence increase the resistance of the surfacing to temperature changes. The stabilising properties of the filler are dependent on its absorptive powers and on the fineness of its particle size. Not all stone can be used in the production of filler, the determining factor being the extent to which the material is hydrophilic. The best results are obtained from powdered lime and silicate of lime. Considerable difficulties are encountered when the filler is added after the binder and aggregate have been mixed, and the author advocates the mixing of the filler and the binder and of the aggregate and the binder in two separate processes.—A. SCHINDLER: *Strasse u. Verkehr*, 1939, **25** (10/11), 174-6. *Road Abstracts.*

# The Waterworks Digest

**Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.**

## Chlorine In Odor Reduction

The Research Committee of the New Jersey Section of the A.W.W.A. has collected, by its own experiments and those of others, data concerning the behavior of high chlorine doses which indicated some interesting conclusions. As the chlorine dose of a given water is increased, the residual increases up to a certain point; then, as the dose is increased further, the residual decreases to or approximately zero; after which the residual increases in proportion to the increase in dose. Another phenomenon noticed in most cases was that odors approximately paralleled the residual, disappearing entirely and finally when it reached zero. It is believed that this increase in odor during the early stages of chlorination is probably due to the production of a new set of chlorinated compounds, some of which have new and often times penetrating odors. As the breakpoint in the residual curve is approached the concentration of chlorine becomes great enough to oxidize these chlorinated compounds, eliminating their fishy, vegetable odors. The amount of chlorine necessary to bring about these changse varies with different waters, and probably from time to time with the same water. There was one water in which this elimination of odors did not take place. Little bacterial life can persist where chlorination is carried into the zone of true oxidizing residuals, *i. e.*, in the zone where the residuals rise following the dip or breakpoint.[A25]

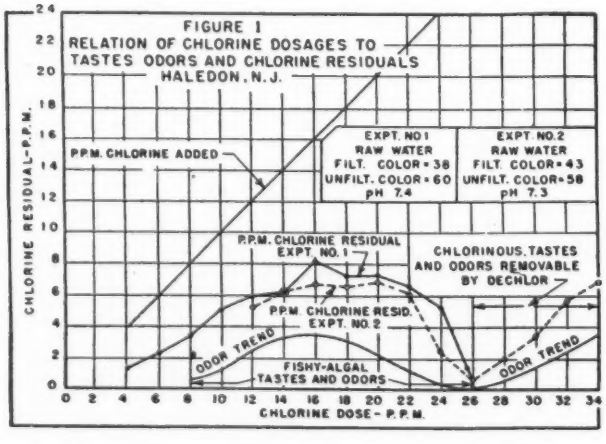
Superchlorination at Tyler, Texas, was tried when heavy coagulation and long filtration periods failed to alleviate tastes and odors. With 1 ppm of chlorine there was a distinct fishy odor; with 2 ppm, a pronounced musty as well as fishy odor; with 3 ppm the odors increased; with 4 ppm there was a slight musty and sweet odor; with 6 ppm there was no detectable odor; with 6.2 ppm there was a chlorine odor. In addition to the odor results, manganese was partially oxidized, giving longer filter runs and bacteria were definitely destroyed.[A26]

## Paying for Water in City Buildings

This is a report of a study by the New York State Bureau of Municipal Information on the practice in cities and villages of charges made for water used in municipal buildings. Of the 40 cities reporting, 14 make no charge for water so used, including schools, while of 48 villages, only 2 make no charge.[J5]

## Domestic Water Consumption

From data collected in a few eastern cities it is concluded that 20 gpd per capita is the absolute minimum amount of water needed to carry out properly the various functions of life—1 gal. for drinking, cooking, etc., 6 gal. for laundry, 5 for ablution (without tub or shower), 8 for two toilet flushes. Each tub bath requires 25 gal.; shower baths, 5 gal. per min.; sprinkling lawn, 7 gpm; washing an automobile, 150 gal. Use tends to become more lavish, but commercial laundries and control of leakage reduces consumption. The net increase may be 1% per year up to a maximum of 50 gal. The minimum domestic urban consumption may be estimated at not less than 30 gal., and may be taken at 40 gal. for design purposes. Local peculiarities have considerable influence—lawn sprinkling, prevalence of one-family or multi-family houses, etc. For apartment houses, 75 gal. is a safe assumption. The few figures available from recent housing projects indicates 45 gal. as a reasonable design figure.[A12]




**These curves show the behavior of high chlorine applications in odor removal from water supplies. Chart courtesy of Journal of American Water Works Assn.**

## Water Rates and Service Charges

The figures given cover domestic and industrial meter rates, discounts and penalties, installation charges, fire hydrant rentals and fire sprinkler charges for 11 cities of various sizes.[J6]

## Tomato-Shaped Water Tank

A new design of steel tank has been built for Brookline, Mass. Capacity is 1.66 mg.; head range is 46 feet; cost of tank, $38,750. To the public, shaped like a tomato, the technical term is "spheroidal." The tank is 90 ft. in diameter at the equator and 47 ft. high above the floor. It consists of bottom and shell plates, the latter shaped to uniformly changing radii. Floor plates were first placed, in erection, and welded, and the staging equipment placed on the flooring. The rib fins were placed, guyed and tack-welded. The first sections of shell plates were then tack-welded, followed by the second set, etc. On the inside of the tank, slightly above the equator is a catwalk. A revolving ladder is hung from the vent cap by a swivel.[F5]

## A Study of Rural Water Supplies

In Fayette Co., Ky., a study was made of rural water supplies. Outside of the city of Lexington, 52.7% of the population was served by municipal mains, 17.5% by shallow wells, 16.2% by springs, 13% by cisterns, and 0.6% "rural chlorinated." Of the shallow wells, 44% were satisfactory, of the springs 31%, of the cisterns 51%. The conclusion reached is that

rural water supplies need improvement, but there is still a great deal to be done in devising effective means of doing this.[F6]

### Tornado-Proof Pumping Plant

Because a tornado destroyed the pumping plant of Newton, Kans., it has installed a tornado-proof reserve supply in the form of a steel surface reservoir of 1 mg capacity and an underground booster station containing a 4 mgd centrifugal. The tank is kept filled by the excess from the main pumping plant. By automatic control, the booster pumps come into service when the consumption exceeds the pumping rate of the main plant.[J3]

### Sterilization of Water Mains

A new set of specifications has been prepared by the Michigan Department of Health covering cleaning and disinfecting new water mains. Under these regulations, the interior of the mains must be swabbed or washed out, flushed and then disinfected. A chlorine application of 40 to 50 p.p.m. is recommended, with a contact period of 12 hours or more. Results should be checked bacteriologically.[F10]

### Sodium Silicates As Aid to Coagulation

The James river water which is used for supplying Richmond, Va., varies in temperature from zero to 30° C, in turbidity from 5 to 3200 ppm, and in alkalinity from 18 to 75 ppm; and contains industrial wastes from paper mills and tanneries. Tests, extending over more than a year, were made on the use of silicates as an aid to coagulating it. From these the authors concluded that sodium silicates properly prepared and used in the correct ratio almost always produce a floc more rapidly than will alum alone; and the floc is generally larger and of improved physical appearance, and settles more rapidly. But, except at low temperatures and turbidities, the floc appears to be much less absorptive and the settled water less suitable for filtration. With iron salts, the silicates appear to be definitely deterimental to coagulation. The cost and inherent difficulties of storing, handling, acidifying and using the sodium silicates would greatly increase the practical problems of plant operation. Where difficulty is experienced with low temperatures and turbidities, iron salts appear to be a much preferred alternative to alum with silicates. Where adequate settling time is not available and mechanical aids to coagulation with iron salts fail to reduce the settling time required, the use of silicates with alum appears to be the best solution of this condition yet known; although the authors are satisfied that filter runs are apt to be materially reduced.[A29]

### Cost of Repairing Water Meters

Elgin, Ill., has made a special study of the time and cost required for repairing 53 5/8-inch water meters and of converting them to the oil enclosed gear train type. The meters repaired were installed between 1906 and 1920 and had open type gear trains. Pay of men ranged from 53 to 63 cents per hour. Labor costs per meter amounted to $1.11; parts were $3.52; miscellaneous items amounted to 24 cents. The total was $4.87 per meter. Accuracy after repair was excellent.[F14]

### Protecting English Water Works From War

Walls of buildings have been strengthened and exteriors buttressed with several layers of sandbags. In many cases, windows are boarded up. Air raid shelters are provided, in basements where possible. Emergency

squads have been organized to repair breaks in mains. Reserves of water have been provided for fire fighting and other use. In London, these are either canvas tanks or underground reservoirs. Some water works have been camouflaged.[F15]

### Photomicrography At Low Cost

Do you like to take pictures of algae and the other minute forms of life that exist in our water supplies? This article tells how to do it with home made equipment and a $12 camera. The equipment required consists of the camera, a small adapter and a microscope, of course. A camera with a ground glass focusing back is excellent, but simpler types can be used. An ordinary desk lamp and 100-watt bulb furnishes the light. Concentration of the samples is by the Sedgewick-Rafter method.[F16]

### Gastro-Enteritis Outbreaks And Engineering

There is still some question regarding the means of transmission of gastro-enteritis, but there is evidence that water supplies may not be entirely blameless. The question is here discussed, with pros and cons, and with specific reference to progress in water purification and the possibility that such knowledge may solve this and other problems.[F20]

### How a Reservoir Leak Was Repaired

A leaky reservoir in St. Charles, Mo., was drained, the walls carefully examined, scraped, hammered and chiseled. The plentiful large cracks in the wall were deeply chiseled out and filled, using ironite. The floor was carefully cleaned and a new 6-inch floor was constructed on top of the old one, using expansion joints to prevent leakage between the slabs. Cost was $9,000.[F21]

### Lake Michigan Water for Grand Rapids

A 30-mile pipe line and two high-head pumping plants are the major features of a new project to bring 55 million gallons of water from Lake Michigan to Grand Rapids, Mich. After studying the daily water consumption and the population trends, the capacity of the plant was based on a 50% increase in the daily demand over a period of the three greatest demand months—July, August and September. Bids were taken on tunnel and on open cut layouts of the line; the former would have saved considerable finally, but the only bid received on this 25,000-ft. 48-inch tunnel was so high that open cut was adopted. Bids for the pipe were received on a straight basis, without any allowance for longer anticipated life, and the contract was awarded for 46-inch diameter concrete pipe at an average price of about $11.50 per foot in place, exclusive of river crossings. A hydrostatic test on the first section of about 3,000 feet showed a leakage of only 14 gals. per inch diameter per mile for 24 hours.[L2]

### Welded Valve Seals

A recently introduced practice in manufacture of gate valves is building up the seats by bronze welding, instead of making the seats of cast bronze and rolling them into dovetailed grooves in the body or securing them by screw threads. The built-up seats become an integral part of the body, which should eliminate trouble sometimes experienced with rolled-in seats becoming loose; and the bronze used in welding

is somewhat harder and definitely more wear-resisting than the cast bronze used in standard construction. The part of the casting to which the seat is to be welded is made approximately 3/32 to ¼ in. below the finished face. The bronze is then applied by means of an oxy-acetylene blowpipe, and finally machined to the desired thickness. If they become worn or damaged by use, they can again be built up by welding and remachined, and be as good as new.[A30]

### Odor Control At Hammond, Ind.

At Hammond, the threshold odor test is used to determine the amount of carbon to be fed to the raw water, a table having been prepared to show the amount needed for removal with each threshold odor unit, the odor being tested every two hours and the carbon dose altered accordingly. This has given "a consistently satisfactory finished water from the standpoint of taste and odor."[A28]

### Water Supply and Purification Progress in 1939

This article is more of a review of the important events in water supply and purification than an analysis. Among the points covered are new styles in elevated tanks; lining water pipes in place with cement mortar by the Tate process (Charleston, S. C.); filter improvements, including the use of porous plate bottoms and the Palmer filter sweep; the use of sodium hexametaphosphate; the revival of interest, on the basis of work by Griffin and others, of superchlorination or, perhaps more properly, "complete" chlorination; the revival also of ozone for water treatment; and many miscellaneous bits of news and practice.[G3]

### Sub-Zero Frost Protection Methods

Up in Quebec, where it really gets cold in the winter, thawing of pipes and hydrants is a commonplace necessity. A portable thawing outfit, consisting of two 15-kva, 2200-volt, 110-220-volt standard transformers, so connected as to reduce voltage to 50 to 55 volts, is used. This thaws ordinary services in a few minutes, and hydrants in an hour or so. Electrical cables are also used; these are wrapped around frozen hydrants, which are covered with canvas or other protective means.[F13]

## *Bibliography of Waterworks Literature*

***The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.***

*c.* Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Ass'n.*
*December*

12. Urban Domestic Water Consumption. By M. A. Pond. Pp. 2003-2017.
13. A Play on Public Relations. By D. R. Taylor. Pp. 2018-2026.
14. Efficient Utilization of Water for Fire Fighting. By C. Goldsmith. Pp. 2027-2036.
15. Consideration of Distribution System Design for Adequate Fire Protection. By G. Tatnall. Pp. 2037-2046.
16. Regulations for Water Main Installations. By H. T. Green. Pp. 2047-2052.
17. Proper Charge for Private Fire Protection. By D. D. Gross. Pp. 2053-2060.
18. Private Fire Protection Charges. By W. D. Masterson. Pp. 2061-2072.
19. t. Friction Losses in Pipe Lines. By H. N. Lendall. Pp. 2073-2084.
20. Maintenance of Electrical Equipment in Water Works. By C. J. Schoeninger. Pp. 2085-2097.
21. A Simple Method of Testing Centrifugal Pumps. By H. E. Beckwith. Pp. 2098-2108.
22. The Water Department as an Independent Utility. By D. C. Egbert. Pp. 2109-2113.
23. The Small Water Department. By J. L. Galloway. Pp. 2114-2117.
24. Differential Gas Pressures in Wells. By T. E. Larson. Pp. 2118-2120.
25. Reaction of Heavy Doses of Chlorine in Various Waters. By A. E. Griffin. Pp. 2121-2129.
26. Super-Chlorination for Waste and Odor Control. By J. M. Lloyd. Pp. 2130-2134.

27. A Definition of "Available Chlorine." By L. L. Hedgepeth and A. M. Buswell. Pp. 2135-2136.
28. Laboratory Control and Operating Experiences at the Hammond, Ind., Filtration Plant. By J. C. Vaughn. Pp. 2137-2148.
29. Studies in the Use of Sodium Silicates. By H. E. Lordley and M. C. Smith. Pp. 2149-2156.
30. Building Up Valve Seats by Bronze Welding. By G. G. Routledge and W. A. Duncan. Pp. 2157-2165.

E *Engineering News-Record*
*January 4*

6. Lake Erie Water for Toledo. Pp. 59-60.

F *Water Works Engineering*
*December 20*

5. A Tomato-Shaped Water Tower. (Brookline, Mass.) By W. B. Bushway. Pp. 1594-1598.
6. Study of Rural Water Supplies. By E. C. Handorf. Pp. 1599-1600, 1604.
7. Has Municipal Operation at Louisville Failed? Pp. 1601-1603.
8. p. Filter Sand Facts Learned Through Investigations. P. 1604.
9. Tennessee Water Operators Being Licensed Voluntarily. By H. D. Schmidt. Pp. 1613-1614.
10. Michigan Instructions for Main Sterilization. Pp. 1625-1632.

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11. Seventy Years of Water Works Improvements. (Covington, Ky.) By J. T. Kingsley. Pp. 8-11, 27.
12. Stopping Revenue Leaks. Pp. 12-13.
13. p. Sub-Zero Frost Protection. By A. K. Grimmer. Pp. 14-16.
14. Cost of Repairing Water Meters. By L. V. Trentlage. P. 16.

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15. Water Supply in Time of War. By J. S. Trevor. Pp. 62-63.
16. Photomicrography at Low Cost. By G. W. Campbell. Pp. 64-66.
17. New York Fears Water Shortage. By E. Neubling. Pp. 67-71.
18. Maintenance Methods of a Small System (East Rainille, W. Va.) By R. F. Hall. Pp. 71, 88.
19. Automatic Diesel Units Cut Operating Costs. (N. Easton, Mass.) By G. B. Bailey. Pp. 72-73.
20. p. Gastro-Enteritis Outbreaks. By J. J. Hinman, Jr. Pp. 76-77, 91.
21. How a Reservoir Leak was Repaired at St. Charles, Mo. By H. A. Insinger. Pp. 91-92.

G *Water Works & Sewerage*
*January*

3. Progress in Water Supply and Purification During 1939. By L. V. Carpenter. Pp. 1-11.
4. Does Main Cleaning Pay? By W. S. Staub. Pp. 12-15.

J *American City*
*January*

3. Tornado Hazards Removed from the Newton, Kas., Water Supply. By K. L. Brode. Pp. 38-39.
4. Lime Water Softening at Granite Falls, Minn. Pp. 44, 71.
5. What Do Cities Pay for Water Used in City Buildings? Pp. 63-64.
6. Water Rates and Service Charges. Pp. 75, 77, 79.

L *Civil Engineering*
*January*

2. Lake Michigan Water for Grand Rapids, Mich. By A. W. Consoer and J. A. Fulkman. Pp. 3-6.
3. Concrete Linings for Irrigation Canals. By C. W. Wood. Pp. 29-32

P *PUBLIC WORKS*
*January*

4. Modern Water Works Plant at Keokuk, Iowa. By W. L. Garrison. P. 15.
5. Successful Taste and Odor Control in El Dorado, Kans. By A. E. French. Pp. 23-24.
6. n. Freezing a Service Line Expedites Reconditioning. P. 40.
7. The Cost of Reading Water Meters. P. 41.

T *Technique Sanitaire*
*September-October*

1. Le Groupment Regional Pour l'Alimentation Publique en Eau Potables. Pp. 141-147.
2. L'Organisation Intercommunale Des Distributions d' Eau en Belgique. Pp. 149-152.

*November-December*

3. La Compagnie Intercommunale des Eaux de l' Aggloemration Liegeoise. (Also of the Province of Anvers, of Brussels and of Flanders.) Pp. 159-166.

V *Journal, Maine Water Utilities, Ass'n.*
*January*

1. Relation Between Standpipes and Supply Mains. By H. U. Fuller. Pp. 12-15.



## VILLAGE OF LIBERTY, NEW YORK

Sealed proposals, endorsed "Proposals for Furnishing Mechanical Equipment for Sewage Treatment Contract "A" will be received at the Vilage Clerk's office, Municipal Building, Village of Liberty, N. Y., until 8 P. M., February 19, 1940, and then and there opened publicly, for the manufacturing, furnishing, shipping, mechanical inspection and supervising of initial operation of mechanical equipment for sewage treatment as specified within the Village of Liberty, N. Y. The equipment shall consist of two (2) Rotary Distributors and Siphon Mechanisms for the Bio-filter; two (2) Sewage Recirculation Pumps; one (1) Secondary Clarifier Mechanism; one (1) Circular Magnetite Filter Mechanism; one (1) Sludge Digestion Mechanism and Gas Utilizing Equipment. Proposals may be made for one or more or all or any combination of the items. The bidder must bid segregated prices on items included in any combination bid. Erection and hauling of equipment will be done under another contract.

Information to bidders, specifications, proposal and contract forms may be obtained upon application to the Village Clerk, Village of Liberty, N. Y., or to W. A. Hardenbergh, Engineer, 310 East 45th Street, New York, N. Y., upon payment of Ten Dollars ($10.00), which amount will not be refunded.

A certified check in the amount of 5% of the total bid price is required with the Proposal. The right is reserved to reject any or all bids.

By order of the Board of Sewer Commission.

VILLAGE OF LIBERTY, NEW YORK
Chandler Borden, Village Clerk.

# The Sewerage Digest

**A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published**

### Settling and Filtration at Denver

The Denver sewage treatment plant consists of three mechanically cleaned bar screens, a grit washing apparatus, grease removal by 15 minutes of preaeration, a paddle mixing tank, chemical treatment, settling tanks with 2 hours detention, magnetite filters, and sludge digestion and drying. The sewage flow averages about 38 million gallons per day. Results of treatment are as follows: The settling process removes 42.5% of the B.O.D. and 70.3% of the suspended solids. Filtration effects a further reduction of 20.8% of the B.O.D. and 30.4% of the suspended solids. The overall efficiency results in removal of 53% of the B.O.D. and 79.4% of the suspended solids. The average B.O.D. of the raw effluent is 151 p.p.m.; of the settled sewage, 86.7 p.p.m.; of the filtered effluent 71 p.p.m. Suspended solids in the raw sewage are 157.3 p.p.m., and in the filtered effluent 32.7 p.p.m. Grit amounted to 1.9 cu. ft. per million gallons of sewage. Gas production amounted to 1.11 cu. ft. per capita per day, based on a population of 260,000. The operating cost was $5.48 per million gallons.[H4]

### Sewerage for 18,000 Soldiers

The Indiantown Gap cantonment of the Pennsylvania National Guard is within a reservation of 13,600 acres; soldiers are quartered within an area of about 3,500 acres, and provision is made for about 50,000 men, total, though there are seldom more than 18,000 in camp at one time—usually not so many. There are 110 mess halls and 58 bath houses equipped with showers and 680 flush toilets. This is not sufficient to care for more than 8,000 to 10,000 men (since toilets should be provided in number equal to about 8% of the command), and the remainder of the troops use pit latrines. Treatment works consist of two screen chambers, 3 Imhoff tanks, sludge beds and chlorination equipment. Flow is normally 0.5 mgd., but may approach 1 mgd. This is equivalent to 45 gallons per man average, with a peak of 65 gals. Imhoff tanks have a total nominal detention period of 2 hours with 12,000 men in camp. Sludge storage capacity is 1 cu. ft. per person; 1,500 sq. ft. of sludge bed area is provided. Discharge is into Swatara Creek, which has a drainage area above the discharge of 333 sq. miles, affording ample dilution.[H5]

### Incinerating Dead Animals in New Orleans

Dead animals are no longer placed directly in the incinerator at New Orleans, since experience has shown that in many cases they are only partly consumed. Therefore a dead animal chute has been constructed whereby animals are deposited in the floor of the combustion chamber, where they are completely destroyed.[H6]

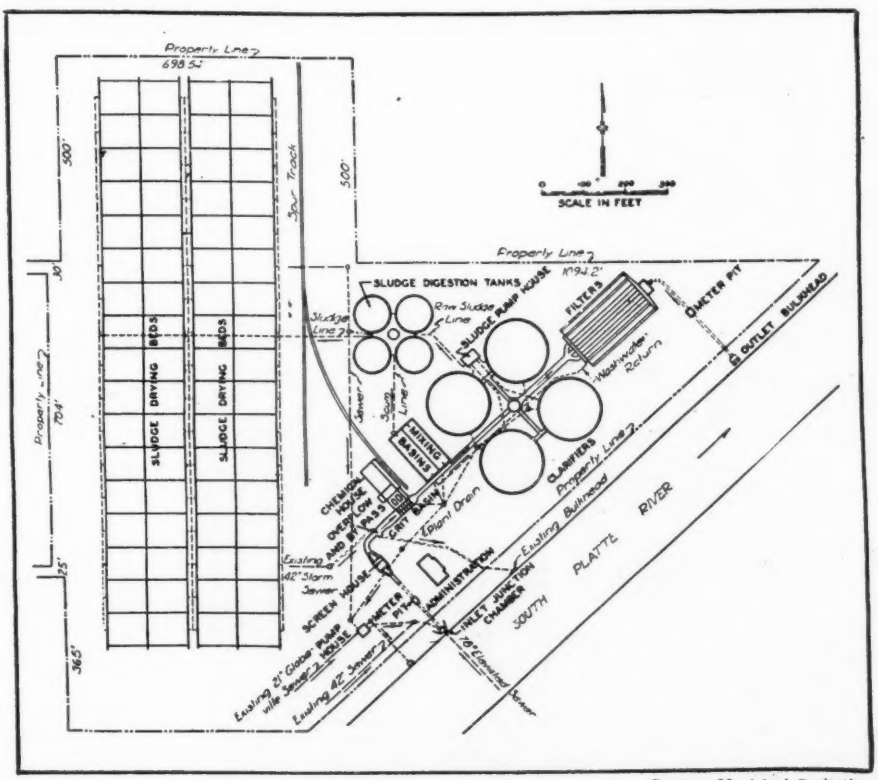
### More Gas Engines for Aurora Plant

Thirty-three months experience with gas engines at Aurora, Ill., sewage treatment plant has been highly favorable, the present engines have paid for themselves and gas production is ample to carry another engine. Gross savings in power costs have been $11,637.11. Power bills of $2,112 per year can be eliminated by the new engine.[H7]

### Trickling Filters in English Practice

Discussing English practices in treating sewage, D. M. Watson compares the activated sludge process and trickling filters. It is the general belief, he says, that the activated sludge process is better suited to the initial flocculation of colloids than is the filter; and the filter is better suited to the oxidation and nitrification stage of the process. "One hour's preliminary treatment in an activated sludge plant will approximately double the capacity of bacterial filters, and will eliminate the smell which settled sewage, distributed over bacterial filters, so frequently causes.

Whether biological filters exist as the only secondary purification plant on the sewage works, or are operated in series with an activated sludge plant, biological filters enjoy such a reputation that engineers will continue to build them at many places. Where the




Courtesy Municipal Sanitation

**General layout of the Denver Sewage Treatment Plant.**

smell and fly trouble is not a serious nuisance, where the area of land occupied by the works is not of first importance, when low operating costs are desirable even at the expense of high initial outlay, or where the works are liable to receive only second-rate supervision, the biological filter is unrivalled and possibly will never be superseded.[D9]

### Cheese-Whey Treatment

The sewage treatment plant at Monroe, Wis., was severely overloaded with cheese plant wastes. This plant is of the activated sludge type, designed for a flow of 300,000 gpd., but actually handling about 500,000 gpd. Considering the strength of the sewage, the plant load is two to three times the designed load. An experimental plant has been developed by the superintendent in an attempt to solve the difficulties resulting from this severe overloading. The addition of lime to the influent of the secondary clarifier has been helpful.[J4]

### Sewer Maintenance

After sewers are laid, they must be kept in order. In Rockville Center, N. Y., a 1½-ton truck with flexible steel rods, turbine type cutters, hose and similar equipment is used, but a 2½-ton truck is now considered preferable. The plan of maintenance is so scheduled that at least 78 miles of sewers will be checked once each three years, or 26 miles per year. A card index is kept of the work done, conditions worthy of note being recorded. Tapax has been found most useful for stopping rattling manhole covers. As a result of the work, there is much stricter inspection of new lines and greater care is being taken in constructing joints. Also, attempts are being made to eliminate, by ordinance, those trees, such as swamp maples, poplars and willows, which are most likely to interfere with sewers.[G6]

## *Bibliography of Sewerage Literature*

***The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.***

*c.* Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

D *The Surveyor*
*December 8*

4. p. Progress in the Methods of Treatment and Disposal of Sewage Sludge. By S. H. Jenkins. Pp. 475-477.
5. Rivers Pollution Prevention as a Public Health Service. Discussion. Pp. 483-485.
6. Collection and Utilization of Waste Materials. (War requirements). P. 487.

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7. Improvements at a Sewage Disposal Works. By H. Eaves. Pp. 495-497.
8. p. Reclamation of Waste Materials from Refuse in War Time. By C. R. Moss. Pp. 505-507.

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9. Sewage Purification and Disposal: British Practice. By D. M. Watson. Pp. 539-541.

E *Engineering News-Record*
*January 4*

7. Sewage Treatment Coupled With Irrigation. (Pueblo, Colo.) By F. M. Veatch. Pp. 48-50.
8. Notes on Sewage Disposal. By W. Rudolfs. P. 68.

G *Water Works & Sewerage*
*January*

6. Sewer Maintenance at Rockville Center, L. I. By C. G. Andersen. Pp. 27-32.
7. p. Sewage Analyses: Significance and Interpretation. By R. Pomeroy. Pp. 33-37.
8. A Sewage Screenings Problem Solved (at Bloomington, Ill.) By O. G. Hendryx and K. Carrington. Pp. 40-41.

H *Municipal Sanitation*
*January*

4. Settling and Filtration at Denver Works. By F. M. Veatch. Pp. 8-10.
5. Sewerage for 18,000 Soldiers. By H. E Moses. Pp. 11-13.
6. Incinerating Dead Animals in New Orleans. By A. Westwater. Pp. 14-15.
7. Additional Gas Engines for Aurora. P. 15.
8. Gas Hazards and Their Elimination. By J. F. Skinner and C. A. Holmquist. P. 23.

J *American City*
*January*

4. Cheese-Whey Removal at Monroe, Wis. By T. R. Kendall. Pp. 49-51.

P *PUBLIC WORKS*
*January*

6. Multiple Digestion of Sludge at Grand Forks, N. D. By K. W. Riley. Pp. 12-14.
7. n. Designing and Building a Storm Sewer in Tunnel. P. 14.
8. n. Paying for Sewage Treatment. P. 24.
9. p. Disposal of Garbage with Sewage. By K. C. Lauster. Pp. 25-26.
10. Use of Sewage Effluents in Irrigation Pp. 32, 34-35.
11. Repairing a 48-Inch Brick Sewer. P. 36.
12. Waste Chlorinated Water Used to Treat Sewage. P. 41.

# *at Ypsilanti* DORRCO CLARIFLOCCULATORS

## *show*

## 31.6% MORE CAPACITY

## *or*

## 21.6% GREATER REMOVALS

The Dorrco Clariflocculator—a combination of a central Flocculator compartment and an outer, annular clarification compartment—is a long step forward in sedimentation practice. Because it mechanically (without chemicals) preconditions the raw feed for more rapid and efficient sedimentation, it gives either greater capacity or higher removals compared with the normal type of sedimentation unit.

The table at the right contains operating data from Ypsilanti, Michigan—31.6% more capacity at same removals; 21.6% greater removals at same capacity. At the right is a list of installations made to date and a table of the fields where the Clariflocculator is directly applicable.

It will pay you to install a Dorrco Clariflocculator in existing overloaded plants. It will definitely step up plant capacity, percent removal or both.

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40' Dorrco Clariflocculator vs. 40' Dorr Clarifier on weak domestic sewage:

| | *Greater Capacity at Same Removals (7 wks. average)* | | *Greater Removals at Same Capacity (8 wks. average)* | |
|---|---|---|---|---|
| | Clari-floccu-lator | Clari-fier | Clari-floccu-lator | Clari-fier |
| Detention—Hrs. | 1.9 | 2.5 | 2.3 | 2.3 |
| O'flow rate—gals./sq. ft./day | 950 | 720 | 800 | 800 |
| Raw Sewage—p. p. m. | 147 | 147 | 155 | 155 |
| Effluent—p. p. m. | 68 | 71 | 66 | 82 |
| Removals—percent | 53.8 | 51.8 | 57.4 | 47.2 |
| Increased capacity—percent | 31.6 | — | — | — |
| Increased removals—percent | — | — | 21.6 | — |

Other tests, of shorter duration, indicate proportionately greater improvements on proportionately stronger sewages.

●

### *INSTALLATIONS*

BAKERSFIELD, CALIFORNIA
CARMEL, CALIFORNIA
COVINA, CALIFORNIA
HILVERSUM, HOLLAND
LEBANON, TENNESSEE
LEWISTOWN, MONTANA
LOVELAND, COLORADO
MARATHON PAPER COMPANY
MIDLAND, MICHIGAN
REUTLINGEN, GERMANY
WAYNE COUNTY, MICHIGAN
WEISSELSTER, GERMANY
YPSILANTI, MICHIGAN

●

### *FIELDS OF APPLICATION*

**WATER**
Coagulation
Softening

**SEWAGE**
Raw • Chemically precipitated
Trickling filter effluent

**TRADE WASTES**
Raw • Chemically precipitated

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When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 63 to 65.

# Improved Sewage Clarification by Pre-Flocculation

By A. J. FISCHER* and A. HILLMAN**

**Conclusions from a paper Presented at the Annual Meeting of New York State Sewage Works Assn.**

THIS paper presents laboratory and plant data that show that sewage clarification may be improved by the use of pre-flocculation without chemicals. Particular emphasis is placed on the advantages of this principle in the primary treatment of raw sewage.

General conclusions that may be drawn from this work are as follows:

1—Laboratory tests showed that pre-flocculation increased the rate of settling and removal of suspended solids from raw sewage, trickling filter effluent and aeration tank (activated sludge) effluent.

2—Plant tests on raw sewage at Cedar Rapids with constant flows, and at Ypsilanti with variable flows demonstrated that improvements as indicated by laboratory tests may be obtained in actual practice.

3—Plant results on trickling filter effluent at Sioux Falls with constant flows were also in general agreement with laboratory tests.

4—Pre-flocculation may be used to advantage in sewage clarification for either increasing the removal of suspended solids or increasing clarifier capacity or both.

5—The suspended solids test is of questionable value in determining the true efficiency of a settling tank, due to possible change in the samples during storage and because the test does not take into consideration flocculatable and nonsettleable solids.

6—A more exact method of measuring the efficiency of a clarifier is to take the ratio of the plant removals to laboratory removals under fixed quiescent conditions. This method might be used in comparing sedimentation units at different plants.

7—At average design flow, minimum flocculator detention of 30 to 40 minutes and clarifier detentions of 1.5 to 2.0 hours with a maximum overflow rate of 800 gals./sq. ft./24 hrs. are recommended for raw sewage flocculation.

8—For trickling filter effluent treatment, 30 minutes flocculation and 1.0 hour settling at a 1,000 gals./sq. ft./24 hr. overflow rate should be satisfactory.

9—More consideration should be given to area and overflow rates than to detentions in the design of settling tanks where flocculation is employed.

10—Due to the fragile nature of some of the flocs produced by pre-flocculation, the inlet and outlet disturbances should be held to a minimum and velocities in and after the flocculator should not be allowed to exceed about 1.5 ft. per second.

11—In general, pre-flocculation is economically justified in the treatment of raw sewage or trickling filter effluent ahead of settling. Its use in the case of activated sludge settling is questionable where good settling conditions prevail.

12—An indication of the popularity of pre-flocculation is its extensive use during the past three years. Its more general application with either separate flocculators and clarifiers or combination type units is predicted.

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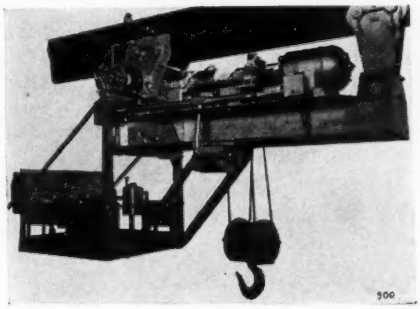
**Westport Mill, The Dorr Company, Inc., Westport, Conn.

# Keeping Up With New Equipment

## Cranes and Hoists for Sewage Treatment Plants

In sewage treatment plants there are various needs for cranes and hoists, mostly for standby purposes, such as removing and handling motors and pumps, lifting ton containers of chlorine, handling sludge and grit, and for general service and handling of equipment. Such use is intermittent, and for



Another Euclid hoist

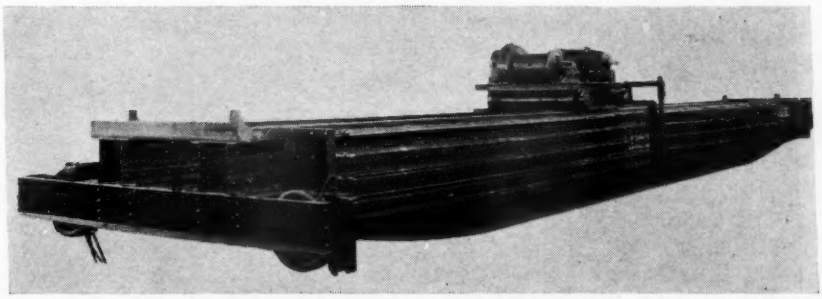
that reason 1-motor or hand power cranes are usually sufficient. In the 1-motor type, the motor is used for hoisting and bridge travel and cross travel are effected by a pendant hand chain.

A monorail hoist is used where a monorail system can be installed economically; it may be constructed as a loop or oval shaped system having a continuous run over sludge beds; and a branch built to the grit chamber. A clam shell or other type of bucket can be used for handling the material.

In designing sewage plants having large pumps, motors and other equipment, which may need servicing or repairs, or where heavy weights must be raised (as chlorine containers), provision for hoists should be made. Data and dimensions on hoists will be supplied by Euclid Crane & Hoist Co., Euclid, Ohio.

## Roto Wing for Widening and Sloping Snow Banks

The Roto Wing is especially designed for high-speed widening through deep snow banks. The wing consists of a blade which imparts a rolling motion to the snow and feeds it into a rotor which discharges it over a wide area. The rotor can be driven either by power take-off from the motor or by an auxiliary power unit. This unit is unusual, in that it slopes the banks to 30° and can clear the snow for a distance of 10 feet beyond the ditch line; the snow is not piled near the road, but can be discharged into adjacent fields, or spread over an area about



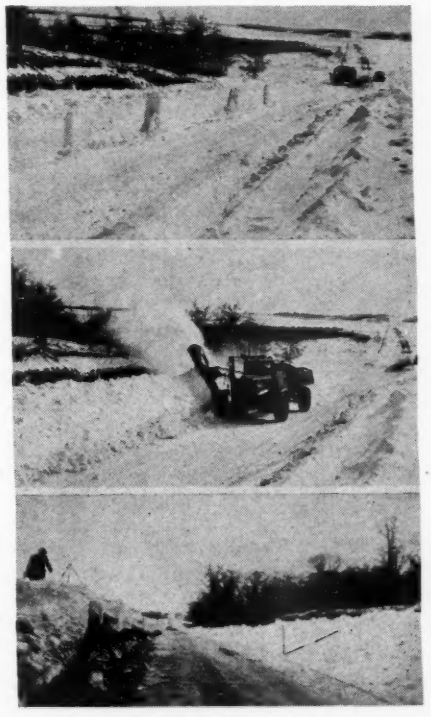
A 10-ton, 3-motor, floor operated Euclid hoist

20 feet wide. In widening and sloping, the speed of the Roto Wing (on a 6-ft. high bank) is 4 to 10 miles an hour, depending on the snow. Full data and catalog from Roto Wing Co., Mound, Minn.

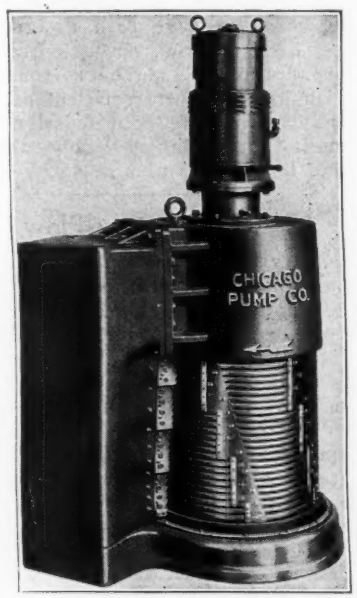
## Comminutor Improvements

Improvements in the design of Comminutors have greatly increased their cutting capacity and the fineness of the cutting. At the same time, the cutting effort has been so reduced that the motor horsepower required has been cut almost exactly in half. The cutting, or shearing, and relief angles between the cutting members are increased, and the clearances between the cutting members made closer. The action of the cutters is now more like shears than like a punch. The new Comminutors have staggered cutters and staggered combs. This improvement has resulted in a smaller amount of material being engaged with the cutting members at one time but a greater number of cuts for each revolution of the slotted cylinder. On one machine there formerly were six major cuts per revolution; now there are forty-two. Instead of a few shock loads, there is now a continuous series of small, fine shearing actions.

A third cutting member, called a shear bar, has been added. It is a removable sharpedged wearing insert. Several of these shear bars are mounted on the slotted cylinder in staggered positions. They shear stringy material that flows only part way through the slots. This prevents such abrasive-ladened material from wedging between the comb and the revolving cylinder and wearing away the latter. With the shear bars the stringy material is cut immediately and is carried through the slots by the flow before the abrasives have had time to wear the cylinder. When wear does occur, only the wearing inserts need be replaced.



How the Roto Wing works




The improved comminutor


**A charming Scotch accent was the feature of Cleveland Tractor's Road Show Exhibit**

Because of the improved cutting action, it has been possible to reduce the number of cutters on the new Comminutors, and thus lower the maintenance cost in replacing cutters. The new cutting or shearing angles between the cutting members have been designed to eject hard material, such as iron and stone, but to retain and cut soft material which has a higher coefficient of friction. Cutters have been redesigned to simplify sharpening so the operator can grind them at his plant.

## Sno-Flyr Rotary Plow

Rotary Snow Plows operating on an entirely new principle have recently been announced by the Wm. Bros Boiler & Mfg. Company of Minneapolis, Minn. It is claimed these plows, of patented construction, will move snow of any nature with a minimum of power. The moldboard of this plow is formed in the shape of a "W" with a double rotor placed in each half of the "W." As the plow is moved forward into a snowbank, the snow is broken by the side and center edges and moves inward along the slant of each of the four sides of the "W." Thus the snow has but a short distance to travel to reach the side of each rotor where it is broken up and thrown far with one motion. Provision is made to throw all of the snow to either side of the road without interfering with the driver's vision. Where a loading plow is desired to load trucks, the same plow can be used with a detachable loading chute which takes the snow from both rotors.

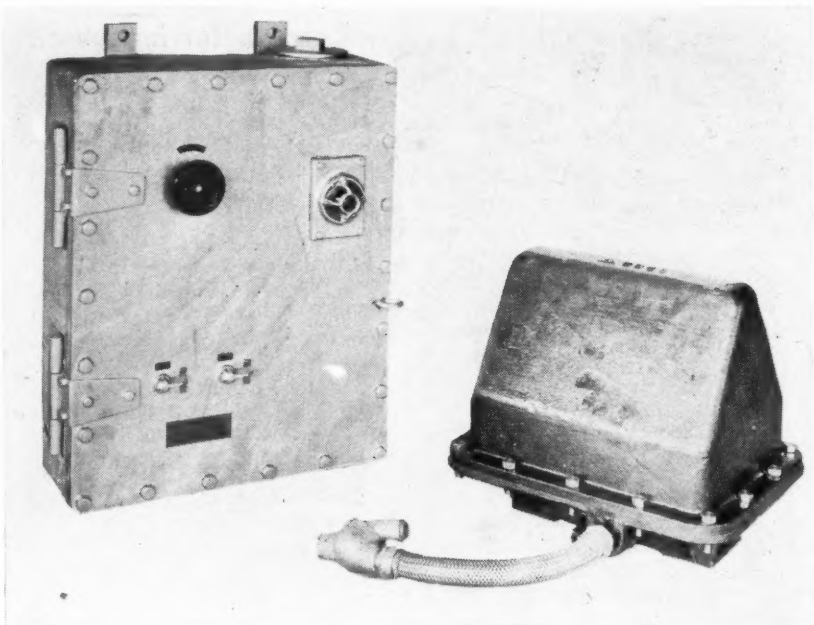
Sno-Flyr Rotaries are made in sizes to fit trucks, tractors or motor patrols and can be furnished with a separate motor to operate the rotors or optionally, in many cases, with drive from the motor of the operating vehicle.

**Bros Sno-Flyr Rotary Plow**

## "Explosion Proof" Vibrators and Controllers

The Syntron Company, 660 Lexington Avenue, Homer City, Pa., have added to their line of vibrators an "Explosion Proof" model, for use in plants where atmospheric conditions are highly inflammable or explosive.

The vibrator, a heavy, pulsating electro-magnet, is fully encased in a thick, electric-furnace steel case, with ground joints, and with an armored cable lead. The remote electric control panel containing a rectifier, operating switches and rheostat for controlling the vibrator's power, is fully encased in a cast iron case, with ground joints and approved explosion proof fittings.



**Explosion Proof Vibrators and Controllers by Syntron**

The vibrators are used for attachment to bins, hoppers, chutes, etc., to prevent arching over and hanging up of material, and to insure a free flow at all times.

## Huber Roller on Pennsylvania Turnpike

On July 17, 1939, Walker Brothers of Chambersburg was awarded the first paving contract on the Pennsylvania Turnpike; on which they used a 7-Ton Huber Motor Roller.

Work on this $886,027.28 contract is well underway, and the 10.28 miles of paving in Cumberland County was the first paving work underway on the Super Highway.

## American Water Works Association

Preliminary applications for exhibit space for the AWWA convention to be held in April, 1940, at Kansas City, Mo., have been received as follows:

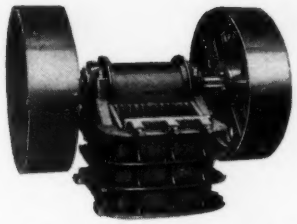
Activated Alum Corp.
American Cast Iron Pipe Co.
American City Magazine
American Rolling Mill Co.
Atlas Mineral Products Co.
Badger Meter Mfg. Co.
Barrett Co.
Birch Mfg. Co.
Buffalo Meter Corp.
Builders Iron Foundry
Carson Cadillac Corp.
Calgon, Inc.
Central Foundry Co.
Chapman Valve Mfg. Co.
Chicago Bridge & Iron Co.
Chicago Pump Co.
Cliffs Dow Chemical Co.
Crane Co.
Darco Corp.
Darling Valve & Mfg. Co.
DeLaval Steam Turbine Co.
Dorr Company, Inc.
Dresser Mfg. Co.
Eddy Valve Co.
Electro Rust-Proofing Co.
Engineering News-Record
Farnan Brass Works Co.
Flexible Sewer Rod Euip. Co.
Ford Meter Box Co.
Foxboro Company
General Paint Corp.
Hayman, Michael & Co.
Hays Mfg. Co.
Hersey Mfg. Co.
Homelite Corp.
Hydraulic Development Corp.
Industrial Chemical Sales
International Filter Co.
Iowa Valve Co.
Johns-Manville Sales
Keasbey & Mattison
Kennedy Valve Mfg. Co.
Layne Bowler Co.
Lead Industries Asso.
Leadite Co.
Lock Joint Pipe Co.
Ludlow Valve Mfg. Co.
M & H Valve Fittings Co.
McWane Cast Iron Pipe Co.
Monsanto Chemical Co.
Mueller Co.
National Meter Co.
Natl. Water Main Cleaning Co.
Neptune Meter Co.
Omega Machine Co.
Pardee Engineering Co.
Permutit Co.
Phoenix Meter Corp.
Pitometer Co.
Pittsburgh-Des Moines Steel Co.
Pittsburgh Equitable Meter Co.
Proportioneers
Public Works
Rensselaer Valve Co.
Ross Valve Mfg. Co. Inc.
Salamon, L. A. & Bro.
Simplex Valve & Meter Co.
Smith, A. P. Mfg. Co.
Sparling, R. W.
Steel Protection & Chem. Co.
Thomson Meter Co.
U. S. Steel Corp. of Delaware
Vogt Mfg. Co.
Wailes Dove Hermiston Corp.
Wallace & Tiernan Co.
Water Leak Detector Co.
Waterous Company
Water Works Engineering
Water Works & Sewerage
Wood, R. D. & Co.
Worthington-Gamon Meter Co.
Youngstown Sheet & Tube Co.

## Hauck Fire-Gun

These fire-guns are useful wherever there are general repairs requiring heat, maintenance work to be done or spring weed-burning needed. There are three sizes, weighing 18 to 30 pounds. Bulletin 1034 is available from Hauck Mfg. Co., Brooklyn, N. Y.

## New Diamond 10-24 Crusher

A new 10 x 24 jaw crusher has been developed by the Diamond Iron Works, Inc., Minneapolis, Minn., for which greater capacity, lower power costs and more uniform product size control are claimed. Specifications, description and illustrations will be sent on request.

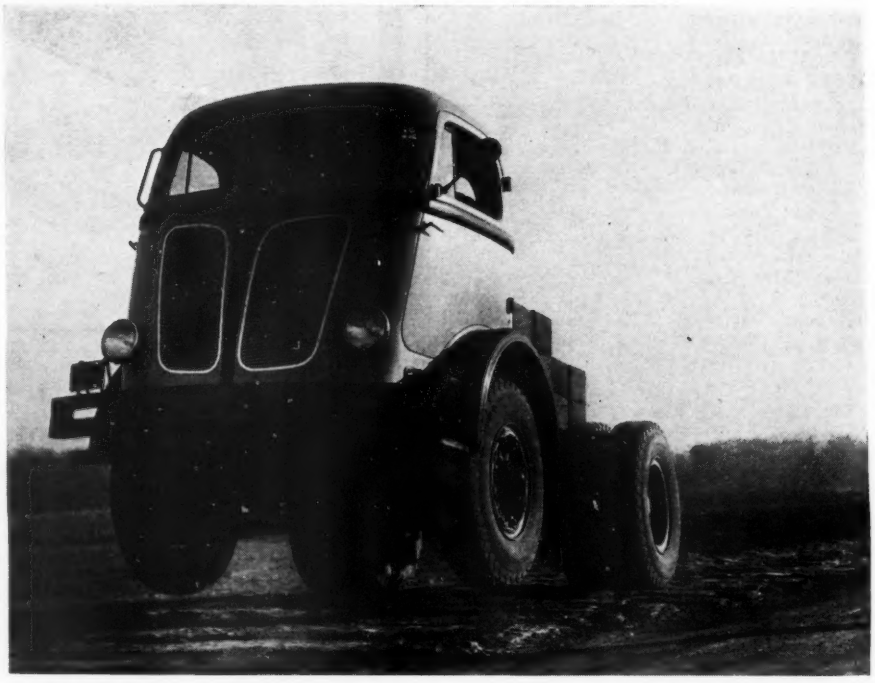


New Diamond 10-24 Crusher

## International Trucks on the "Test" Course

*Left:* The concrete "twist course," in which are depressions ranging in depth from 12 inches at one side to 19 inches on the other, built at 45-degree angles across the road, provides unusually severe tests for trucks driven over it at slow speeds. This shows a side view of Model DR-700 International. Note that front wheel on the right-hand side and rear wheel on the left-hand side are both in the depressions, while the opposite wheels are on the higher part of the roadway.

*Below:* This picture, made with a high-speed camera, shows how a truck, operated over Belgian block section of the test course, reacts when it strikes the high spots in this unusually rough pavement.



## Austin-Western "99" Power Grader Catalog

This is a 24-page bulletin with excellent illustrations of the new "99" grader at work under a variety of conditions, and with descriptions and specifications. Rough grading, terracing and drainage, heavy ditching, mixing, maintaining, snow plowing, scarifying and other jobs are covered. Sent on request to Austin-Western Road Machinery Co., Aurora, Ill.

## Bucyrus-Erie 1¼-Yd. Shovel

A new 32-page bulletin is available which describes fully improvements in the Bucyrus-Erie 33B, 1¼-yd. shovel, dragline, clamshell and crane. Mechanical and structural features are fully explained and clearly shown. Field views are included. Sent on request to Bucyrus-Erie Co., South Milwaukee, Wis. Ask for Bulletin 33B-3.

## Gate Valves

This bulletin tabulates the specifications to which Kennedy valves are built, outlines features of the hook-and-wedge operating mechanism, describes the various methods of control and the accessories available, and contains a complete table of dimensions of bell-end and flanged valves, with and without gears, and in sizes from 3-inch to 48-inch. Excellent illustrations. Bulletin 59. Kennedy Valve Mfg. Co., Elmira, N. Y.

## Diesel Engines

Hercules Motor Corp., Canton, O., has issued a booklet on high-speed heavy-duty diesel engines in which questions and answers are used to present comparisons between diesel and gasoline engines, and between the various types of diesel engines.

American Locomotive Co., Auburn, N. Y., has issued a booklet describing Alco diesel engines and their application to many types of work. 16 pages; excellent illustrations.

## Ozone Processes

A contract has been awarded by the Borough of Denver, Pa., to Ozone Processes, Inc., Philadelphia, to ozonate the borough water supply. The installation was designed by F. H. Dechant of William H. Dechant & Sons, Consulting Engineers, Reading.

Joseph Metzendorf has been appointed Eastern Field Representative and H. H. Adams heads the installation department and is responsible for pilot plant test work, according to a recent announcement by Morse DellPlain, president of Ozone Processes, Inc.

## New England Water Works Association

The 59th annual convention of this association will be held at the Hotel Commodore, New York City, September 24 to 27, 1940. Marcella Sachs, 613 Statler Bldg., Boston, Mass., is assistant secretary.

## New Jersey Sewage Works Association

The Terminology Committee of the New Jersey Sewage Works Association, W. C. Mallalieu, Chairman, P.O. Box 188, Boonton, N. J., will publish a commercial section, giving trade names and definitions for any product which may be of interest to the members of the association, provided suffi-

cient terms are received to make such a section desirable. Such data are solicited, but the committee reserves the right to use their own judgment in handling the terms.

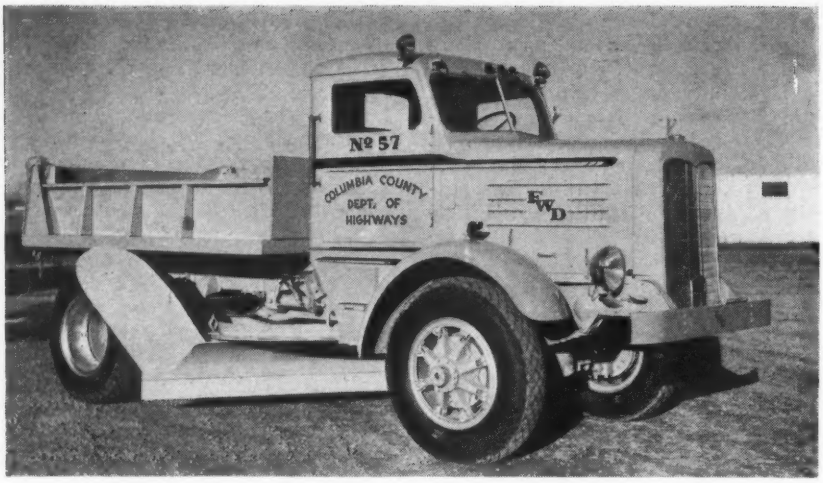
## PERSONAL NEWS AND APPOINTMENTS

The following new appointments have been reported by our readers:

Ben W. Barber, Rooks County Engineer Stockton, Kan. R. C. Sangster, Adair County Engineer, Kirksville, Mo. J. W. Bruner, City Engineer, Jeffersonville, Ind. Chas. O. Thomas, Manager, Hope Water & Light Plant, Hope, Ark. V. M. Freeman, Manager, Santa Paula Water Works Ltd., Santa Paula, Calif. Laurence Tate, Sonoma Municipal Water Works, Sonoma, Calif. H. J. Adams, Superintendent, North Illinois Water Corp., Streator, Ill. P. M. Van Ackerin, Superintendent, Water Works, Light & Power Plant, Atlantic, Iowa. Alan B. Mawdsley, Water Works Superintendent, Pratt, Kan. K. G. Tancler, Superintendent of Water & Sewage, Ada, Okla. Wayne G. Bryan, Superintendent, Portage Water Department, Portage, Wis. T. E. Martin, Ringgold County Engineer, Mt. Ayr, Iowa. H. F. Dorr, Cambria County Engineer, Ebensburg, Pa. Geo. J. Gildea, Water Works Superintendent, Danbury, Conn. F. G. Doggett, City Engineer and Water Works Superintendent, Mt. Airy, N. C. J. Theo. Olson, City Engineer and Manager, Columbia Heights, Minn. Q. B. Jones, City Engineer, Indiana, Pa. J. P. Flynn, City Engineer, Colton, Calif. Leslie A. Davis, City Engineer, Danbury, Conn. Merle J. Miller, City Engineer, Goshen, Ind. R. T. Montgomery, City Engineer, Raton, New Mexico, Raymond J. Whitney, City Manager, Yonkers, N. Y. F. A. Thomas, City Engineer, Euclid, Ohio. John Oliver Hall, City Manager, El Reno, Okla. John T. Cunningham, Jr., City Engineer, Clarksville, Tenn. W. Jeff Cox, Manager and Superintendent, Municipal Light & Water Dept., Crown Point, Ind. Carl Larrison, Superintendent City Water Works Dept., Logansport, Ind. Ira E. Messenger, Superintendent of Water Works, Medina, Ohio. Albert R. Davis, Superintendent of Water Dept., Austin, Tex. W. G. Bester, Clarke County Engineer, Osceola, Iowa. G. W. Houser, Dickinson County Engineer, Abilene, Kan. C. J. Edwards, Sheridan County Engineer, Hoxie, Kan. R. N. Forsberg, Jackson County Highway Engineer, Jackson, Minn. Max L. Cunningham, LeFlore County Supervising Engineer, Heavener, Okla. J. G. Dodd, Adams County Road Engineer, Ritzville, Wash. J. C. Woodul, Nevada County Judge, Prescott, Ark. J. W. Phillips, Trinity County Surveyor, Lewiston, Calif. J. W. Barkley, Contra Costa County Surveyor, Martinez, Calif. A. J. Watson, Plumas County Surveyor, Quincy, Calif. E. E. Nelson, Plymouth County Engineer, LeMars, Iowa. W. E. Stewart, Seward County Engineer, Liberal, Kan. Hebbert Henderson, Estill County Judge, Irvine, Ky. J. C. Horton, Wayne County Judge, Monticello, Ky. Wm. G. Spahr, Buffalo County Highway Commissioner, Kearney, Nebr. H. D. Endersby, Harper County Engineer, Buffalo, Okla. Bob Davis, Uvalde County Judge, Uvalde, Tex. Col. W. W. LaPrade, Chesterfield County Surveyor, Richmond, Va. David Miller, Sweetwater County Engineer, Rock Springs, Wyo. Chas. C. Craig, Harvey County Engineer, Newton, Kan. L. J. Johnson, McLean County Highway Superintendent, Washburn, N. D. Scott Gibbs, Delaware County Surveyor, Jay, Okla. M. B. Shultz, Hansen County Highway Superintendent, Alexandria, S. D. R. G. White, Bexar County Engineer, San Antonio, Tex.

Raymond F. Garcia, formerly general manager of sales of the Central Foundry Co., has been appointed a Vice President of the company.

Joseph C. Woodman and John E. Morris, who have been connected with Decarie incinerators for the past 25 years, have severed their connections with the Nichols Engineering & Research Corp., New York, which firm acquired the Decarie rights in 1938.




**FWD truck with a blade for removing ice mounted under the body**

## Removing Ice Ruts With FWD Center Scraper

On this unit, which is mounted on a FWD truck, a scraper plow is placed under the truck unit, the plow being carried entirely on springs. A tripping device permits the blade to slide over obstructions, as manhole covers; cutting pressure is maintained by two hydraulic rams. Extra high road clearance is provided. With this unit it is possible to remove rutted ice from pavements and streets. Full information from Four Wheel Drive Truck Co., Clintonville, Wisc.

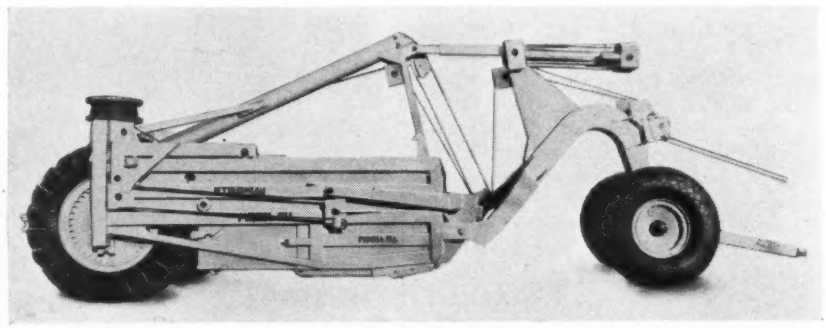
## Specifications for Cut-Back Asphalts

Revised specifications for Cut-Back Asphalts, adopted by The Asphalt Institute, December 13, 1939, have been issued in pamphlet form and are available, without charge, upon request. This pamphlet discusses and illustrates the changes in specification requirements and presents the new specifications for Rapid Curing (RC) and Medium Curing (MC) materials, methods of tests and principal uses for cut-back asphalts. Address requests for these Revised Specifications (issued as Construction Series Number 51) to The Asphalt Institute, 801 Second Avenue, New York, N. Y., or to its nearest District Office.

## Model SU Carryall Scraper

To meet the increasing demand for a scraper that will handle more "pay dirt" per pound draw bar pull, R. G. LeTourneau, Inc., has designed and placed on the market a new, double bucket, cable controlled Carryall Scraper—the SU—rated at 14 cubic yards struck capacity and 18 heaped.

To minimize loading effort and make the greater yardage possible the scraper blade is narrowed to 8′6″, and a double bucket bowl used. The narrow cutting edge and two telescoping buckets give the effect of loading successively two small scrapers with a large tractor, and, according to the manufacturer, should result in capacity loads and extra yardages. After the first bucket is loaded to capacity, it is drawn back while the second is being loaded. This double bucket loading method is designed to eliminate costly voids in the rear of the bowl and at the top of the tailgate.



**The Le Tourneau Carryall Scraper with double bucket, SU model, 14 to 18 cu. yds. capacity**

## Oil Burning Water Heaters

To meet the need for oil burning water heaters able to heat large quantities of water quickly for winter construction needs, and do it cheaply, Hauck Mfg. Co., Brooklyn, N. Y., has developed two new heaters, No. 308 and No. 309. These are guaranteed to produce hot water within two minutes after starting. Bulletin 503 describes these units.

## Multiple Unit Valve and Vane Type Pumps

These are titles of the two newest bulletins on power hydraulic controls for road building, road maintenance and snow removal equipment. How standardized units can be combined and assembled to meet individual requirements is featured in Bulletin 40-13; Balanced Vane Type Pumps in 6-12. Address Vickers, Inc., 1400 Oakman Blvd., Detroit—or ask us to have these sent you.